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CONTENTS

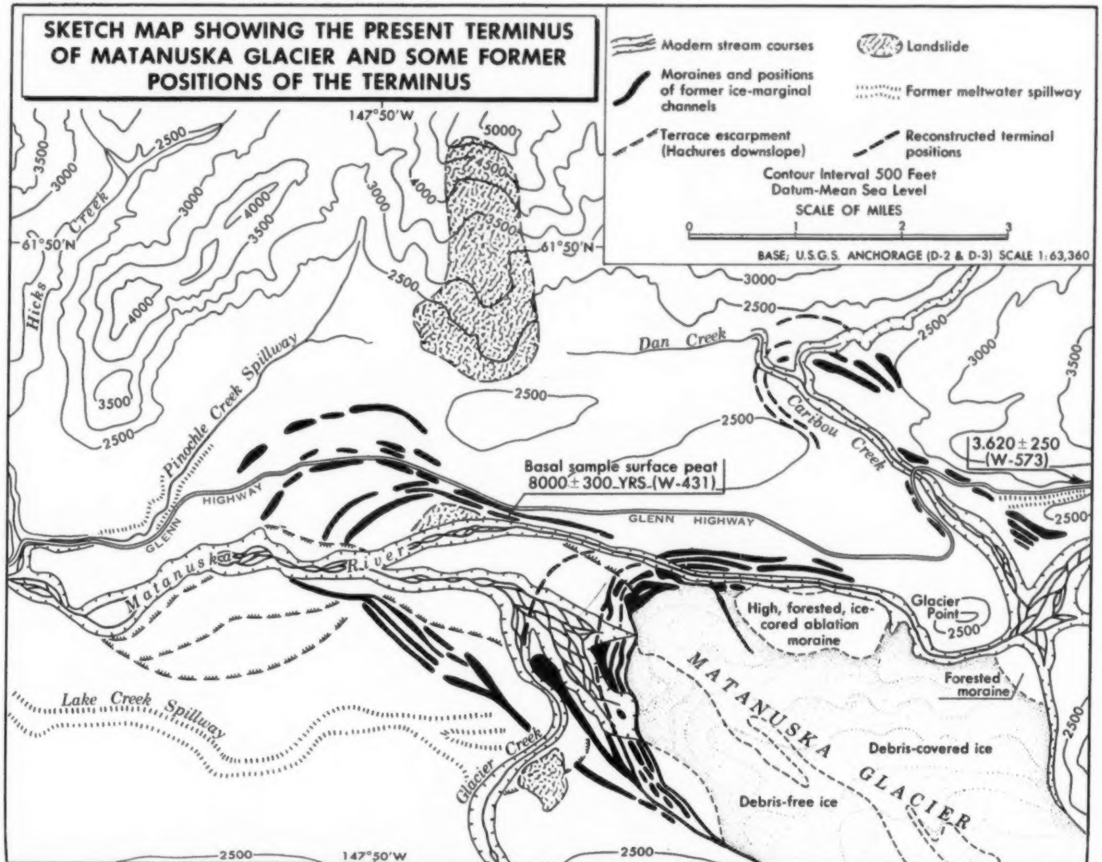

Fig. 1. Sketch map showing the present terminus of Matanuska Glacier and some former positions of the terminus.

LATE WISCONSIN AND RECENT HISTORY OF THE MATANUSKA GLACIER, ALASKA*

John R. Williams and Oscar J. Ferrians, Jr.†

The Matanuska Glacier (Fig. 2) is one of the largest glaciers that extend north from the snow and ice fields of the central Chugach Mountains of southern Alaska. It drains 250 square miles of the highest part of the range between Mt. Witherspoon (12,023 feet) and Mt. Marcus Baker (13,176 feet). The glacier terminates in the upper Matanuska Valley that separates the Chugach Mountains from the Talkeetna Mountains to the north. The terminus, 82 miles northeast of Anchorage, is visible from "scenic overlooks" between mileposts 98 and 108 on the Glenn Highway and is accessible by a cable car across the Matanuska River at J. D. Richardson's residence near milepost 103. Studies of the glacier in 1953, 1954, and 1957 were part of the authors' investigation of the glacial geology of the southwestern Copper River Basin and upper Matanuska Valley. The studies are a part of the program of terrain and permafrost investigations in Alaska by the U. S. Geological Survey, and are financed in part by the Office of the Chief of Engineers, U. S. Army. A preliminary report on the history of the Matanuska Glacier was given at the Ninth Alaska Science Conference, College, Alaska in 1958 (Williams and Ferrians, 1958).

The glacier lies in a 2-mile-wide valley that is a southeastern tributary of the valley occupied by the Matanuska River. The terminal lobe of the glacier occupies a 4-mile segment of the Matanuska Valley between Glacier Creek and Caribou Creek. The glacier has forced the Matanuska River against the northern edge of its valley, where the river has cut bluffs in which glacial drift, siltstone, and porphyritic igneous rocks are exposed.

Most of the northern part of the terminal zone is stagnant (Fig. 1) and covered by ablation moraine. The southern part of the ablation moraine is free of vegetation because the ice is at shallow depth and the surface materials are still actively slumping and washed by meltwater as the ice melts. Along the northern edge of the ablation moraine, however, the deposit is thick enough to provide a relatively stable environment for the growth of willows and in some places of spruce forest, even though the moraine is

* Publication authorized by the Director, U.S. Geological Survey.

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still cored with ice. The western part of the terminal zone is free of debris, and the clear white ice exposed in the seracs and crevasses of this part of the glacier forms the spectacular view seen from the highway. A large medial moraine and several smaller ones are formed by the coalescence of the lateral moraines of the main forks and those of smaller tributary glaciers. Mendenhall (1898), the first to describe the glacier, remarked that the western part of the glacier was more active than the northern or northeastern part because of different meteorological conditions in the snowfields that feed the two principal forks of the glacier.

The principal meltwater streams flow from below the western part of the terminus. These channels carry a greater volume of water than the upper Matanuska River east of the glacier. Modern outwash deposits form the lowest alluvial level on the outwash plain west of the glacier. Older outwash deposits graded to one or another of the younger group of moraines within 1 mile of the glacier form terraces on this plain.

The U-shaped profile of the valley into which the lower Matanuska River is cut, the truncated spurs on the mountains bordering the valley, and the glacially smoothed bedrock knobs and deposits of glacial drift in the valley bottom show that the glacier was formerly of much greater extent and that it filled the valley during Wisconsin time. At the head of Knik Arm (Fig. 2) near Palmer the Matanuska Glacier at that time coalesced with Knik Glacier; the combined glaciers flowed west and formed the prominent end moraine complex that extends from Anchorage to Willow. This end moraine is of Wisconsin age (Naptowne glaciation of Karlstrom *in* Péwé *et al.* 1953; Karlstrom 1955, 1957; the Elmendorf moraine of Naptowne age of Miller and Dobrovolny 1959, pl. 1 and p. 85). The retreat of the ice from this moraine had a complex history, which is not yet fully understood. However, studies by Trainer (1953, 1960) in the lower Matanuska Valley near Palmer show that the Matanuska lobe of the glacier became stagnant. No prominent end moraines were seen by the authors or by Trainer (1960, p. 27) in the rough terrain of the valley bottom between Palmer and a point 5 miles from the present glacier terminus.

The readvances, which extended 2.5 to 5 miles beyond the present terminus, formed a series of moraines and marginal channels along the Matanuska River and in the lower valley of Caribou Creek. The position of these moraines and marginal channels at a lower altitude than the old valley floor shows that the ice readvanced into a river valley cut into the drift of Wisconsin age that was deposited during the time the valley was full of ice. The upper Matanuska River was blocked by ice, and a lake was formed near the confluence of the east and southeast forks of the river as indicated by stratified silt, sand, and clay at the surface in the valley bottom. These deposits, like the moraines on Caribou Creek, have been deeply incised by the modern streams. To the south the valley of Glacier Creek was blocked by ice and its waters either diverted down the valley of Lake Creek or conveyed into the channels along the margin of the glacier. During this same period the glacier advanced to a point 3 to 4 miles up Caribou

Creek where at least three morainal ridges lie near the mouth of Dan Creek. When the glacier occupied these positions meltwater drainage was ponded, together with the water of Caribou Creek, and was diverted westward across the present valleys of Dan and Pinochle creeks to Hicks Creek. This spillway is now blocked by a large landslide that forms the divide between Dan and Pinochle creeks. The deep canyon of Pinochle creek now followed by the Glenn Highway between mileposts 97 and 98 was cut by water at some time during these advances. The canyon of Caribou Creek was cut as the ice retreated from moraines near Dan Creek.

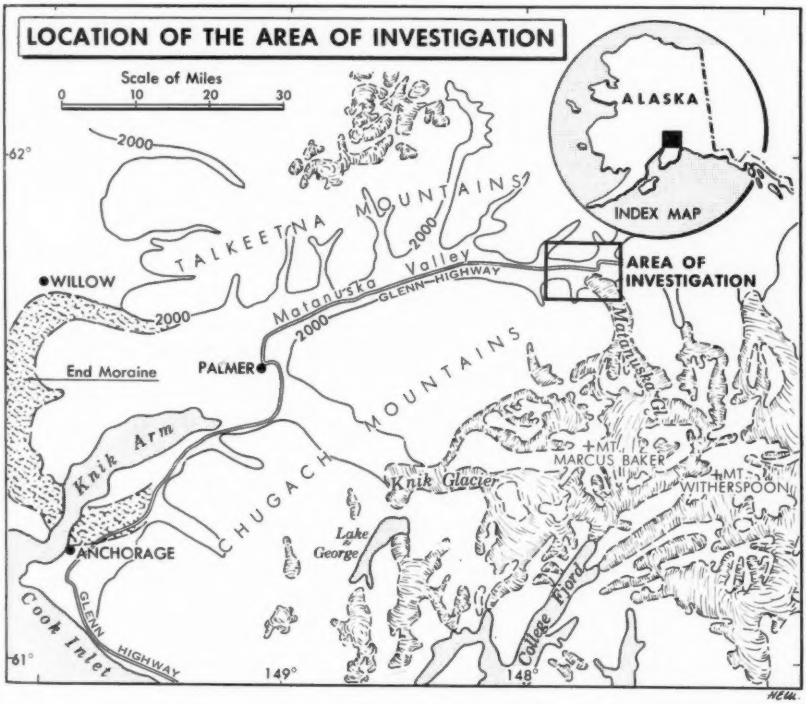

Fig. 2. Location of area of investigation.

The ice occupied successively less extended positions as it retreated from the morainal complex 5 to 2.5 miles west of the glacier. The innermost of these positions is marked by a marginal channel about 100 feet above the modern outwash plain. The river has exposed an oblique section of this channel (Fig. 3) about 400 feet S. 20° W. of milepost 102. Most of the material into which the channel is cut is composed of poorly stratified glacial

drift. A thin lag gravel above the drift is covered by 2½ feet of pond silt that in turn is overlain by 4 feet of peat at the top of the section. The silt contains mollusks of the following species: *Pisidium casertanum* (Poli), *Valvata lewisi helicoides* Dall, *Gyraulus parvus* (Say), *Physa skinneri* Taylor, *Armiger crista* L., and *Lymnaea* sp. (U. S. Geol. Surv., Cenozoic Locality No. 19191). According to D. W. Taylor, U. S. Geol. Surv., who identified the mollusks, their habitat was one of perennial, shallow, quiet water, possibly a pond or swamp or a sheltered stream margin. The configuration of the silt deposits and the fauna suggest that the water body filled a depression that had been formed by the damming of the channel by the alluvial fan of a tributary creek after meltwater had abandoned the channel.

Fig. 3. Bluff north of Matanuska River near milepost 102 on Glenn Highway with exposure of poorly stratified drift (a) overlain by a thin veneer of lacustrine deposits and peat (b); the base of the peat is 8,000±300 years old (W-431).

Above the silt lie 4 feet of uncompressed peat. In the peat are three horizontal, undisturbed, thin beds of white to orange volcanic ash. Material from the basal inch of the peat was submitted for radiocarbon analysis by the Geological Survey. Its age is 8,000±300 years (W-431, Rubin and Alexander 1958). Two conclusions can be reached concerning the age of the glacial deposits near the glacier terminus: (1) the pond silt and dated peat overlie the innermost channel associated with glacial advances 2.5 to 5 miles from the glacier and, therefore, these advances and the channel

must be older than 8,000 years; (2) because the peat is the surface deposit and is not deformed, and because the ash beds show no disturbance, the glacier has not advanced during the last 8,000 years over this site, located only 6,000 feet N. 80° W. of the terminus.

The implication of this radiocarbon date, therefore, is that more than 8,000 years ago the glacier terminated no more than 2.5 miles down-valley from its present position or, in the case of the marginal channel, 6,000 feet away at the edge of the valley. This information is consistent with that from other glaciers with a northern or precipitation-deficient exposure. Capps's (1916, p. 74) studies of the 39-foot peat section exposed in the north bank of the White River, only 8 miles from Russell Glacier, show that that glacier retreated from the locality more than 7,800 years ago. Similarly, in the Nelchina Valley in the northern Chugach Mountains, 22 miles east of the Matanuska Glacier, the ice had withdrawn to within 8 to 10 miles of its present position 8,450±200 years ago (L-368, Olson and Broecker 1959). In the northwestern Kenai Mountains the Tustumena Glacier is reported (Karlstrom, oral communication 1957) to have advanced to positions 4 to 13 miles from the present glacier between 6,000 and 9,000 years ago. Thus the conclusion that the Matanuska Glacier had only slightly greater extent prior to 8,000 years ago than now seems to be borne out in a general way by the available data from other glaciers in similar positions with respect to precipitation.

Following abandonment of the innermost marginal channel prior to 8,000 years ago, the Matanuska Glacier retreated upvalley, perhaps southeast of its present terminus. As soon as the region became free of ice, and perhaps even before, the valley floor was subjected to erosion by the Matanuska River, and a canyon about 100 feet deep was excavated in the pre-8,000 B.P. drift. The glacier readvanced into the deepened valley and formed the younger group of moraines within 1 mile of the present glacier. The duration of the retreat is not known, nor is the date of initiation of the readvance to positions within a mile of the present glacier. However, in a road cut north of mile 108.8 (at the east edge of the map area, Fig. 1) occur deposits of outwash gravel that probably are related in age to the deposits of the pre-8,000 B.P. drift 2.5 to 5 miles west of the glacier. The outwash gravel is overlain by a soil consisting of organic silt, silt, and lenses and beds of volcanic ash. The soil is buried under 4 feet of talus rubble. The organic silt horizon of this soil is 3,620±250 years old (W-573, Rubin and Alexander 1960) by radiocarbon analysis. Though not demonstrable, burial of the soil by talus rubble probably reflects a climatic change that accelerated the formation of talus and that caused the readvance of Matanuska Glacier. The period of retreat preceding readvance to positions within a mile of the glacier, therefore, is most logically correlated with the Altithermal, and the moraines within 1 mile of the glacier probably are no older than 4,000 years.

The younger group of moraines within a mile of the glacier terminus consists of ridges or groups of ridges one mile, a quarter of a mile, and less

than a quarter of a mile west of the terminus (Fig. 4). The only remnant of the moraine representing the 1-mile advance is a ridge that partly blocks the mouth of the canyon of Glacier Creek. An equivalent moraine remnant forms a ridge north of the Matanuska River. At both localities the open-textured morainal deposits consist of slabby, angular fragments of schist, slate, and graywacke that are similar to the rocks of the central Chugach Mountains. Near Glacier Creek these deposits overlie silty till, which includes rounded boulders, and in a few places the moraine is covered with a mantle of as much as 12 inches of eolian silt or loess. The upper 4 to 5 inches of the loess is oxidized. The vegetation consists of second-growth brush and some mature spruce. This moraine is the oldest of the younger group of moraines that post-dates canyon cutting. The age of the oldest moraine may be a few thousand years, but less than 4,000; however, evidence for dating this moraine precisely is not available.

Fig. 4. Matanuska Valley opposite the mouth of Glacier Creek. The canyon of Glacier Creek (a) is partly blocked by moraine (b), one mile from the present terminus. The slightly terraced outwash plain (c) separates the moraine (b) from two younger moraines (d) that lie within a quarter of a mile of the present terminus of Matanuska Glacier and are probably less than 4,000 years old.

A single ridge, the remnant of an advance of about a quarter of a mile, is located south of the outwash plain. The ridge is covered with mature spruce forest; the oldest tree measured is about 125 years old. This forest

differs from the usual pioneer forest in its lack of balsam poplar of nearly the same height as the spruce, and by having a thick carpet of *Hypnum* moss. The age of the moraine as suggested by the character of the forest is probably greater than several hundred years.

Within a quarter of a mile of the terminus is a group of morainal ridges. These moraines are covered with the same pioneer forest that colonizes alluvium after a new bar is formed. The vegetation consists of willow and balsam poplar seedlings on the inner ridges and mixed stands of 100- to 125-year-old spruce and balsam poplar on the outer ridges. Some of the ice-cored ablation moraine in the stagnant northern part of the glacier is covered with spruce forest that may be equivalent in age to that growing on the outer ridges of the morainal sequence within a quarter of a mile west of the terminus. The outer ridges of this group of moraines probably were formed 150 to 200 years ago, although they may be much older.

Immediately adjacent to the glacier is a fresh, unvegetated moraine that in some places has ponded the drainage. This moraine marks the outer limit of ice-cored moraines along the western part of the terminus. This moraine was formed during an advance prior to 1898 when the first photographs of the glacier were taken.

Photographs taken by Mendenhall in 1898 from Glacier Point were duplicated as nearly as possible by the authors in 1954. Comparison shows relatively little horizontal retreat, but considerable thinning of the ice is indicated by the enlargement of the areas of ablation moraine. The ice in one locality on the west side of the terminus has advanced in recent years over a till ridge; this was brought to the authors' attention by J. D. Richardson, who lives near the glacier. The amount of the advance and the portion of the glacier involved are apparently very small.

The late Wisconsin and Recent history of the Matanuska Glacier is summarized as follows:

(1) Enlargement of the glacier to fill Matanuska Valley, coalescence with Knik Glacier, and formation of the moraine between Willow and Anchorage in Wisconsin time.

(2) Retreat from the end moraine between Anchorage and Willow; stagnation of the glacier in the lower Matanuska Valley; canyon cutting.

(3) Readvance 2.5 to 5 miles from the present glacier terminus prior to 8,000 years ago, blocking Matanuska River and diverting Caribou and Glacier creeks.

(4) Additional canyon cutting and glacial retreat to a position perhaps upvalley from the present terminus (Altithermal).

(5) Readvance into the deepened valley, probably during the last 4,000 years, and formation of moraines that are located one, a quarter, and less than a quarter of a mile from the glacier. Minor advance prior to 1898 and formation of vegetation-free moraines. Little horizontal retreat but considerable thinning of the ice since 1898.

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POPULATION DYNAMICS OF THE MACKENZIE DELTA REINDEER HERD, 1938-1958

Charles J. Krebs*

THE value of the reindeer *(Rangifer tarandus)* as a domestic grazing animal of the arctic and subarctic regions has long been known in Eurasia. In 1926 Canada considered establishing reindeer in the arctic and commissioned A. E. Porsild to undertake a 2.5-year survey of the country between the Alaska-Yukon boundary on the west, the Coppermine River on the east, Great Bear Lake on the south, and the Arctic Ocean on the north, to determine the best area to locate a reindeer herd. As a result of this survey (Porsild 1929) a 6600-square-mile Reindeer Grazing Preserve was set up just northeast of the Mackenzie Delta, N.W.T.

The reindeer to be used for the introduction were purchased in Alaska in 1929. They were driven 1600 miles from Kotzebue Sound on the west coast of Alaska to the east bank of the Mackenzie River. The trip was begun with 3440 reindeer in December 1929, and the herd had dwindled to 2370 animals when it reached the Mackenzie River in March 1935 (Crerar and Bonnycastle 1936).

The original plan of the experiment was to set up a *main herd* of reindeer owned by the government that would form a nucleus. Periodically from this nucleus smaller herds would be cut out. These smaller herds, the *native herds,* would be turned over to suitable Eskimos and each herd would be given its own winter and summer ranges. Ultimately it was hoped that these native herds would become self-supporting units, managed by Eskimos. Unfortunately this objective has never been completely realized. Since 1936 six separate native herds have been established and all but one have been failures (one herd established in 1954 was still in operation in 1959).

A considerable body of data, none of which had been analyzed, on the population changes of these herds was extracted from the files of the Reindeer Station, Aklavik, N.W.T. by the writer. Part of this information was obtained at annual roundups of each of the herds commencing in 1936. During the roundup a record of the number of animals in each sex and age class was obtained. Some of the figures given include estimates (see below) of groups of animals that either could not be corralled or subsequently escaped. All other figures refer to actual counts. Additional data were extracted from monthly tallies of the known reductions (slaughter, predation, etc.) in each herd.

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The purpose of this paper is first to analyze the changes undergone by the reindeer population during the period 1938-1958 in terms of birth rate, death rate, and dispersal rate, and second to investigate the effect of herd size and composition on birth rate and dispersal rate.

Changes in total numbers

An over-all picture of the fluctuations in the Mackenzie Delta reindeer herd is shown in Figure 1, which gives the changes in total numbers of all herds combined over the period 1938-1958. Error limits, represented by vertical lines, have been placed on those totals in which any estimation was involved. These error limits have been selected arbitrarily as + 20 per cent and — 50 per cent of the estimates, since estimates of this type tend to be high rather than low (Pulk 1958), and it is believed that this range should include the true number estimated. For example, if 1000 animals were estimated to have escaped corralling, the error limits on this estimate would be placed at 1000 — 500 and 1000 + 200, or between 500 and 1200 animals.

The components on which this curve is based, that is, the main herd and the several native herds, could now be analyzed, but this does not seem necessary here. In summary, six native herds were cut out from the main herd between 1939 and 1954. Usually about 1200 to 1800 reindeer were used to start a native herd. Almost all native herds showed the same pattern of change, i.e., rising numbers for a few years and then a steady decline resulting in the liquidation of the herd when the remaining reindeer were returned to the main herd. Detailed information on all native herds may be found in Krebs (1959).

Causes of changes in numbers

There are three forces that govern the rise and fall of all animal population — birth rate, death rate, and dispersal rate (immigration and emigration). Any fluctuation in total numbers can be ascribed to changes in one or more of these forces, and thus an assessment of these three factors is needed to analyze the population dynamics of any group of animals.

An assessment of these three factors for the Mackenzie Delta reindeer may be made in the following way. Birth rate may be measured by the annual number of fawns provided by actual counts made in late July each year at the roundup. This is of course not the true birth rate, since fawning occurs during April and May, but the fawn losses are almost always slight, approximately 2 to 15 per cent of the total fawns in this herd, in contrast to not infrequent heavy calf losses in the Canadian caribou (Kelsall 1957). Death rate is derived from the known reductions through slaughter, sickness, injury, predators, drowning, and other causes that are recorded each month by the chief herder. Slaughter is by far the most important cause of

death. Dispersal rate may be measured by the number of animals "unaccounted for." Each roundup count usually reveals a discrepancy between theoretical and actual herd size, which is tallied as the "number unaccounted for." By far the greater part of this figure is the result of losses from animals straying and hence this figure provides a measure of dispersal rate. The fate of these strays is usually death, although some do join caribou herds to the southeast. It should be realized that the "number unaccounted for" is not strictly an independent variable because it is obtained by subtraction and includes all errors made in assessing the other two variables. Nevertheless, it does not seem that this is a serious objection to the analysis because the two variables "number of fawns" and "number of reductions" are quite accurately determined by actual counts and the error involved in obtaining the "number unaccounted for" must be quite small. It should be clearly realized that in the following discussion both death rate and dispersal rate are factors acting to reduce herd size. The distinction between them regards the kind of reduction, death rate measuring principally the number slaughtered for food and dispersal rate the number lost by straying.

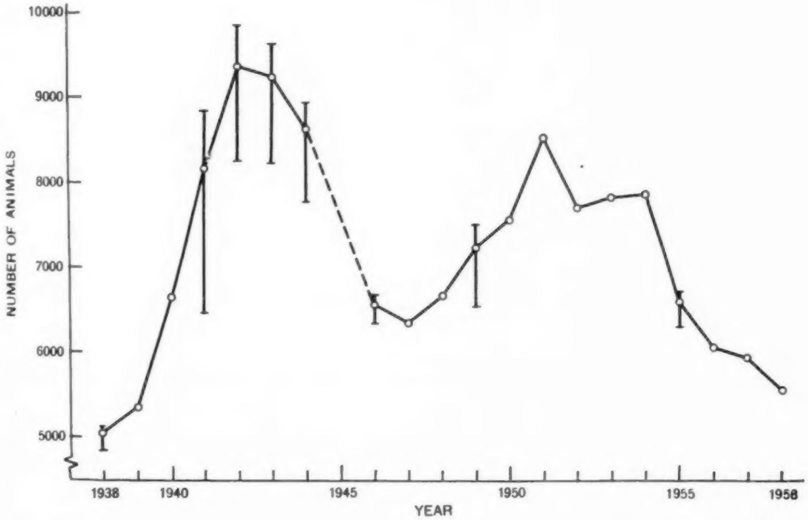

Fig. 1. Total animals in all herds combined, Mackenzie Delta reindeer, 1938-1958. Vertical lines represent error limits of + 20 per cent to — 50 per cent on those totals in which any estimation was involved. The roundup in 1945 was unsuccessful.

The effect of these three primary factors of population fluctuations on the total annual increment of the herd may be analyzed by means of the techniques of multiple regression and correlation. An explanation of these techniques may be found in Snedecor (1956, Chapter 14) and Walker and Lev (1953, Chapter 13). There are two approaches we could use toward this

problem: (1) analyze the three factors together, neglecting the fact that dispersal rate is not independently determined; or (2) analyze birth rate and death rate only, omitting the dispersal rate from the analysis. Statistically, however, both these approaches lead to the same numerical result, the dispersal rate of (1) being the equivalent of the error term (Snedecor 1956) of (2). The first approach will be used in the following analysis.

Table 1 lists the figures for total annual increment, birth rate, death rate, and dispersal rate and forms the foundation on which the following analysis is based. Here again we are dealing with the over-all picture, the data for all herds combined.

The question we are attempting to answer using multiple regression analysis is this: which of the three factors of birth rate, death rate, and dispersal rate is most influential in determining the variations in the total annual increment to the herd? Because we are not interested in prediction and the geometrical form of the multiple regression equation, but rather in comparison of the relative importance of three factors, the multiple regression equation is more useful in its standard form. Using the Doolittle Method (Walker and Lev 1953) of solving the normal equations, we obtain for the generalized equation:

$$Y^* = b^*_{y1.23}\ X_1 + b^*_{y2.13}\ X_2 + b^*_{y3.12}\ X_3$$

and the following for the reindeer data:

$$Y^* = 0.342\ X_1 + (-0.475)\ X_2 + (-0.674)\ X_3$$

where Y^* = estimated standard measure value of total annual increment
X_1 = birth rate term
$b^*_{y1.23}$ = standard partial regression coefficient of X_1 on Y
X_2 = death rate term
$b^*_{y2.13}$ = standard partial regression coefficient of X_2 on Y
X_3 = dispersal rate term
$b^*_{y3.12}$ = standard partial regression coefficient of X_3 on Y

The negative values of $b^*_{y2.13}$ and $b^*_{y3.12}$ imply that as X_2 or X_3 increases, Y decreases. Since the standard partial regression coefficients are in standard measure and hence independent of the scale or variability of the variables, they can be compared directly. Since $b^*_{y3.12}$ is largest in absolute value, X_3, the dispersal rate, is the most important of these three factors in determining the variations in the value of Y, the total annual increment. X_2, the death rate, is of less importance, and X_1, the birth rate, is of least importance in determining the variations in the value of Y (because $b^*_{y2.13} > b^*_{1.23}$).

The multiple correlation coefficient may be computed for the above regression to test the significance of the whole regression. This gives a perfect correlation,

$$R_{y.123} = 1.000$$

Indeed, this is just what would be expected, since by definition

Total Increment = No. born — No. died — No. dispersed

A more precise analysis of the relative importance of the three variables, X_1, X_2, and X_3, may be made using a breakdown of the sums

of squares as given by Snedecor (1956, p. 437). These results are given in Table 2. For each of the three variables we obtain the sum of squares that is due to that particular variable after the effects of the other two variables have been removed, thus determining the amount of the total variation that may be attributed to that particular variable alone. Table 2 shows that X_3, the dispersal rate, accounts for nearly twice as much of the variation observed in Y as does X_2, the death rate, and for nearly five times as much of the variation observed in Y as does X_1, the birth rate.

Table 1. **Total number, total annual increment, number of fawns, number of reductions, and number unaccounted for, Mackenzie Delta reindeer, all herds combined, 1938-1958.**

Year	*Total number*	*Total annual increment*	*Number of fawns*	*Number of reductions*	*Number unaccounted for*
1938	5031	—	—	—	—
1939	5342	311	1896	997	588
1940	6635	1293	1934	422	219
1941	8157	1522	2141	549	70
1942	9374	1217	2411	865	329
1943	9231	−143	2287	1250	1180
1944	8609	−622	2173	1571	1224
1945	—	—	—	—	—
1946	6568	−1000	2189	964	2225
1947	6343	−225	1780	734	1271
1948	6679	336	1857	813	708
1949	7219	540	2104	784	780
1950	7560	341	2133	681	1111
1951	8522	962	2302	790	550
1952	7697	−825	2206	1268	1763
1953	7814	117	2243	1390	736
1954	7844	30	2172	1427	715
1955	6595	−1249	1743	1786	1206
1956	6075	−520	1535	1183	872
1957	5941	−134	1712	1288	558
1958	5571	−370	1521	652	1239

Table 2. **Breakdown of the multiple regression sum of squares into its components.**

Source of variation	*Sum of squares*	*d.f.*	*Per cent of total*	*Ratio*
X_1 after $X_2 + X_3$ (natality)	1,280,554	1	11.6	0.2
X_2 after $X_1 + X_3$ (mortality)	3,560,302	1	32.3	0.6
X_3 after $X_1 + X_2$ (dispersal)	6,184,088	1	56.1	1.0
Error	0	16	0	
Total	11,024,944	19	100.0	

Thus fluctuations in the total annual increment of the Mackenzie Delta reindeer herd over the period 1938-1958 were due primarily to the dispersal rate, secondarily to the death rate, and least of all to the birth rate. It

does not seem feasible to extend this type of analysis to an individual herd basis because the number of observations (years) is too small to permit a meaningful statistical analysis.

Losses by straying have been recognized by the government as an important drain on the reindeer herds. Since 1938 straying losses have totalled about 17,000 animals. Steps are now being taken to decrease straying losses by fencing part of the range.

Age distribution

The age distribution of a population is important from the point of view of both reproduction and mortality. Mortality usually varies with age and reproduction is restricted to certain age groups. The proportion of the reproducing fraction of the population determines in part the reproductive rate. An expanding population characteristically shows a prevalence of the young age groups.

Because of its domestic nature the reindeer presents a rather artificial age distribution. Because there is an annual selective slaughter of animals, the age distribution is directly affected by man and does not represent a situation that would be found in nature. The tendency at the annual slaughter is to select the older mature animals and the 5- to 7-year-old steers. Because of this the possibility exists of setting up an optimum age distribution that will afford a maximum rate of reproduction in conformity with the desired herd size, slaughter yield, and composition. In practice this optimum age distribution cannot be achieved because of practical difficulties, but it is at least approached.

Table 3. Age distribution, Mackenzie Delta reindeer, all herds combined, 1938-1958.

Year	*Females*		*Bulls*		*Steers*		*Fawns*		
	adult	*yearling*	*adult*	*yearling*	*adult*	*yearling*	*female*	*male*	*castrated*
1938	1839	469	329	530	447	—	719	698	—
1939	1859	672	387	514	303	57	772	758	20
1940	2161	820	389	375	547	409	918	370	646
1941	2610	936	548	467	907	548	1119	720	302
1942	3356	1036	439	629	999	504	1206	809	396
1943	3690	1140	511	632	867	104	1141	614	532
1944	3081	1073	621	552	1081	28	1050	815	308
1945	—	—	—	—	—	—	—	—	—
1946	2580	774	81	211	601	132	1131	404	654
1947	2387	795	105	217	507	552	870	437	473
1948	2205	1187	185	220	353	672	942	415	500
1949	2821	683	195	242	656	518	1037	589	478
1950	2841	739	316	345	717	469	1086	695	352
1951	3285	821	300	477	910	427	1141	555	606
1952	3167	503	317	150	996	358	1059	631	516
1953	2862	807	246	422	844	388	1113	607	525
1954	3053	716	320	338	733	512	1044	517	611
1955	2566	593	325	218	686	464	837	523	383
1956	2554	539	339	282	499	327	794	241	500
1957	2516	370	286	126	601	330	841	871	—
1958	2204	476	289	584	497	—	738	783	—

Table 3 presents the age distribution of the Mackenzie Delta reindeer, all herds combined, for 1938 to 1958. The data for 1938 to 1947 and 1949 to 1950 include groups of animals whose numbers were estimated but which were not segregated into sex and age classes (usually less than 5 to 10 per cent of the total). These animals were distributed in all the sex and age classes in the same proportions as found in the segregated and classified groups. The data for the other years are actual counts. Some discrepancy will be noted from one year to the next in certain groups (e.g. fawns castrated in relation to yearling steers). These discrepancies are the result of two things: (1) inaccurate classification of animals by workers at the roundup; and (2) the apportionment procedure for incorporating unclassified groups into the totals.

Table 4 summarizes the percentage age composition of the herd over the period 1938 to 1958 by giving the average and range for each age class in the population.

The question may be asked, what is the relationship between the sex and age distribution and the observed changes in abundance and productivity of the herd? Any changes caused by sex and age distribution must show their effects on the birth rate, the death rate, or the dispersal rate. Of these three we may dismiss the effects on the death rate because the death rate is artificially determined, being selective both to age and sex.

Table 4. Percentage age composition of the Mackenzie Delta reindeer herd over the period 1938-1958.

Age group	*Percentage of total herd*	
	average	*range*
Adult Females	37.6	32.0—42.3
Yearling Females	10.6	6.2—17.8
Adult Males	14.0	8.1—19.8
Yearling Males	10.1	5.2—13.4
Female Fawns	13.8	12.2—17.2
Male Fawns	14.0	12.2—16.1

Effect on birth rate

Three factors that may directly affect the birth rate have been investigated: (1) number of adult females; (2) herd size; and (3) number of adult bulls. Because of the type of analysis involved it is necessary to restrict discussion to one herd, and hence the following analysis refers to the main herd only.

It would be expected that the number of adult females would affect the birth rate. The regression of the number of adult females against the number of fawns for the main herd only is shown in Figure 2. Although the points are moderately scattered, the correlation coefficient ($r = 0.91$) is highly significant ($P < 0.0005$). This regression indicates that over the interval covered by the data (number of adult females in the main herd

500-2400) the tendency is for the increase in number of fawns to be about 70 per cent of the increase in the number of adult females, i.e., the addition of 100 more adult females to the herd would result on the average in the production of 70 more fawns per year. This suggests that fawn production per adult female occured at a relatively constant rate over the interval.

Herd size may affect the birth rate by way of its direct effect on the number of adult females and indirectly by the "herd effect", i.e. by the reproductive rate per adult female being a function of density or herd size. The difficulty encountered here is the separation of these two effects. This may be achieved by computing two regressions: (1) herd size against reproductive rate measured by fawns/adult females expressed as a percentage (main herd only); and (2) herd size against the number of fawns produced (main herd only). The first regression measures only the "herd effect". This was calculated and gave a complete scatter of points ($r = 0.0$), which suggests that no "herd effect" was in operation over the herd size range represented. The second regression in this case measures only the direct effect of increasing the number of adult females. This regression was calculated and, as would be expected, was very similar to Figure 2 and highly significant ($r = 0.95$, $P < 0.0005$).

The number of adult bulls may affect the birth rate if it has any effect on the fertility rate of the cows. Many males are castrated each year to avoid difficulties in herd handling during the rut. It is believed that only about one male in seven is needed for adequate fertilization of the cows. A regression of number of adult bulls against number of fawns was calculated and showed a wide scatter of points with a weak positive correlation ($r = 0.21$, $P < 0.25$). Thus it was concluded that the number of adult bulls showed very little relationship to the number of fawns produced within the limits of these data.

Effect on dispersal rate

Two factors that might affect dispersal rate are herd size and number of yearlings.

Numerous authors have found in other animals that dispersal rate increases as the population size increases (Errington 1954; Chitty 1955; Kluijver 1951; Andrewartha and Birch 1954, Chapter 5). This effect may be minimized up to a point by the herd instinct of reindeer. The regression of herd size against the "number unaccounted for" was calculated for the main herd and gave a complete scatter of points without correlation ($r = 0.0$). Thus over the range of herd size of the main herd (1500-6200) during the period 1938 to 1958 there is no apparent relation between herd size and number of straying losses. Nor does there appear to be any relation between herd size and the percentage loss by straying, the points again falling in a complete scatter.

It is believed that most of the strays are yearling animals because this group as a whole tends to wander more than any other (Pulk 1958).

In view of this, the regression of the number of yearlings against the "number unaccounted for" was calculated for the main herd over the period 1938 to 1958. This resulted in a complete horizontal scatter of points and a very low non-significant negative correlation ($r = -0.10$). This suggests that there is no relation between the number of yearlings in the herd and the number of straying losses.

In view of these facts and other information, it seems probable that the number of straying losses is determined principally by factors extrinsic to the herd itself, notably perhaps by weather, insects, and humans as well as by their many interactions.

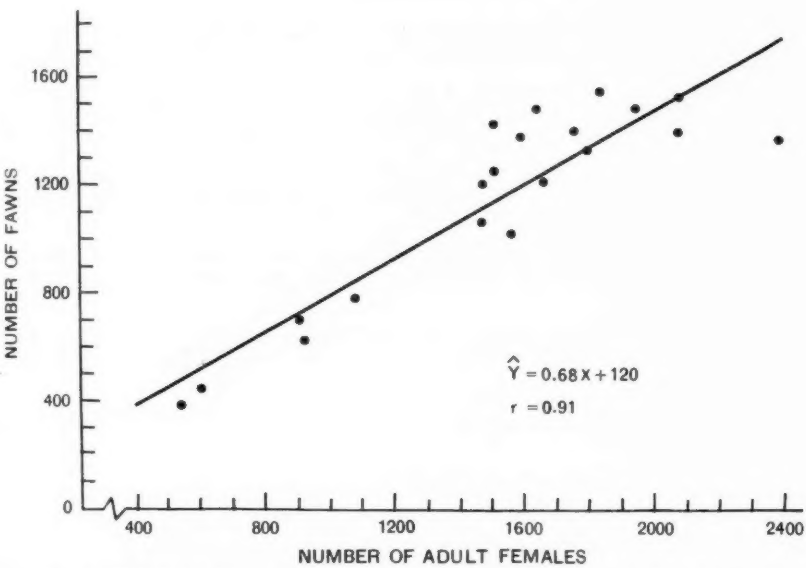

Fig. 2. Relation between the number of adult females and the number of fawns, main herd only, 1938–1958

Summary

1. A brief history of the Mackenzie Delta reindeer herd is given. This herd has consisted of a nucleus *main herd* and *native herds* operated by Eskimo owners. All native herds but one have been liquidated. They show a recurrent pattern of rising numbers for a few years and then decline, usually resulting in liquidation of the herd.
2. The effect of each of the three population determining factors (birth rate, death rate, and dispersal rate) on the total annual increment to the herd is analyzed. It is shown that dispersal rate (losses by straying) was the most important factor and birth rate the least important factor in determining variations in the total annual increment to the herd over the

period 1938 to 1958. The relative importance of each is indicated in the following ratio: birth rate, 0.2; death rate, 0.6; dispersal rate, 1.0.

3. The age distribution of the herd over this period is given. There is no evidence of any changing effect of the observed sex and age distributions on either birth rate or dispersal rate within the range of the data available. Dispersal is not related to herd size or to the number of yearlings present in the herd and appears to be primarily a function of factors extrinsic to the herd itself.

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RUSSIAN SETTLEMENT AND LAND RISE IN NORDAUSTLANDET, SPITSBERGEN

Weston Blake, Jr.*

Introduction

DURING the course of the Swedish Glaciological Expedition to Nordaustlandet (North-East Land), Spitsbergen in the summers of 1957 and 1958 the writer devoted particular attention to the morphology and age of the raised beaches that have developed since the coastal areas of the island have become partly deglaciated. When the ruins of a Russian hunting hut on Nordre Russøya, Murchisonfjorden (Figs. 1 and 2) were visited in September 1957 with Prof. G. H. Liljequist and other members of the Swedish-Finnish-Swiss IGY Expedition, it was immediately realized that these ruins could provide valuable information about the rate of land rise, a subject that is currently being discussed for many parts of Spitsbergen (see Feyling-Hanssen 1955a, 1955b; Feyling-Hanssen and Olsson 1959-60; Donner and West 1957; Birkenmajer 1958a, 1958b, 1959, 1960a, 1960b; Jahn 1958, 1959a, 1959b; Büdel 1960; Corbel 1960; Christiansson 1961; and Blake 1961). This site, previously described in detail by Carlheim-Gyllensköld (1900, pp. 164-81) after his visit with the 1898 preparatory expedition for the Swedish-Russian Arc of Meridian Expedition (1899-1902), was therefore revisited in August 1958, at which time a precise levelling was carried out. The present paper is a report on this work.

The lagoon, Russelaguna, on the east side of Søre Russøya was also visited to search for the main Russian settlement. This was reported by Carlheim-Gyllensköld as it had been described to him by a Capt. Pedersen, and was supposedly occupied by a number of hunters for 36 years. As noted by Liljequist (1957, p. 277), however, no remains of this Russian settlement were found. It is most unlikely that all traces of the huts could disappear in such a relatively short time, even though solifluction occurs here and other hunters may have taken away much of the timber (Carlheim-Gyllensköld 1900, p. 169). No bones, wood, bricks, or other artifacts were seen except the ubiquitous reindeer antlers and, judging by the great amounts of bone and other debris lying around the solitary hut on Nordre Russøya, there should have been a very large quantity here. One can only conclude that the settlement was elsewhere or that it never existed.

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The only other evidence seen of former Russian visits to Murchisonfjorden is the large cross on Krossøya (Figs. 1 and 3), first reported by Nordenskiöld (1863, p. 7) after his visit with Torell's Swedish Expedition to Spitsbergen in 1861.

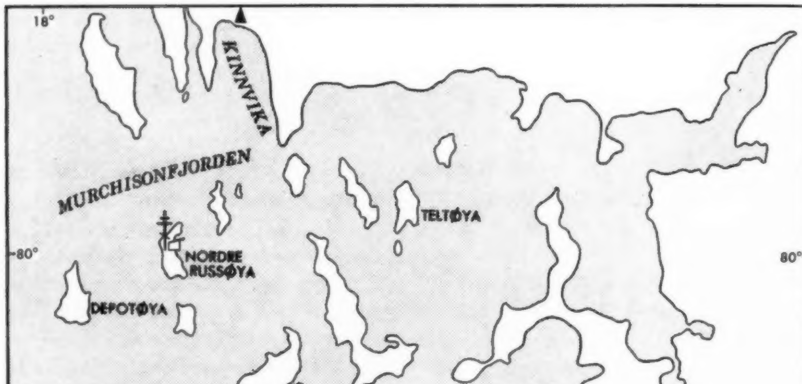

Fig. 1. Murchinsonfjorden, Nordaustlandet, Spitsbergen. (Base map by G. De Geer, 1923).

Levelling results

The hut ruins on Nordre Russøya are situated near the northeast corner of the island about 8 metres from a lagoon, which in turn is separated from the bay by a prominent shingle bar 30 metres wide (Figs. 4 and 5). The

rubble in the middle of the hut is 1.8 metres above mean sea-level, but the general flat area — a beach developed on a thin cover of till overlying dolomite bedrock — around the hut lies at only 1.5 metres. The top of the shingle bar is 1.4 metres above mean sea-level.

Fig. 2. Detail of the Russian hut on Nordre Russøya. View west toward the cross. The hut measures 5 x 5 metres and the remains of the brick fireplace were found in the corner nearest the camera. The C-14 age of the timber indicated by the arrow is 260±100 years.

Tidal observations at the Swedish-Finnish-Swiss IGY base in Kinnvika (July-August 1958), and earlier observations by the Swedish-Norwegian Arctic Expedition (1931) at Sveanor on the south side of Murchisonfjorden and by the Oxford University Arctic Expedition (1935-36) in Brennevinsfjorden (Fjeldstad 1939, p. 372; Hornbæk 1954, pp. 16-7), indicate a mean range of approximately 0.6 metres. Our times of levelling were carefully noted and later were compared with the marigraph records from Kinnvika. In the absence of a *Balanus* line on the beach, the level of the water surface below a small ridge of sand and seaweed left by the preceding high tide was measured, and all altitudes were then corrected to mean sea-level.

Thus the outside of the hut is only 1.2 metres above high-tide level. Furthermore, a line of seaweed on the inner side of the lagoon near the hut

was 0.7 metres above mean sea-level (arrow in Fig. 5). This seaweed indicates the water level at extreme high tides or during storms, and the hut is only 0.8 metres above this level.

Fig. 3. View east at the cross on Krossøya. Note inscriptions in Church Slavonic. The lower oblique crossbar is missing.

History of Russian settlement

The exact time when the hut on Nordre Russøya was built is unknown, but a considerable amount of evidence suggests that it is about 160 years old. According to Conway (1906, pp. 226, 233-4) Zorgdrager reported Russian ships in Spitsbergen waters in 1697, but Zorgdrager, whose book was published in 1720, makes no mention of Russian hunters wintering on the islands. Therefore, their first settlements probably were established sometime between 1720 and 1740, as by 1743 Russians were known to have wintered there for several years. Russian hunting stations were established first on the shores of Storfjorden, particularly Edgeøya, and later on the

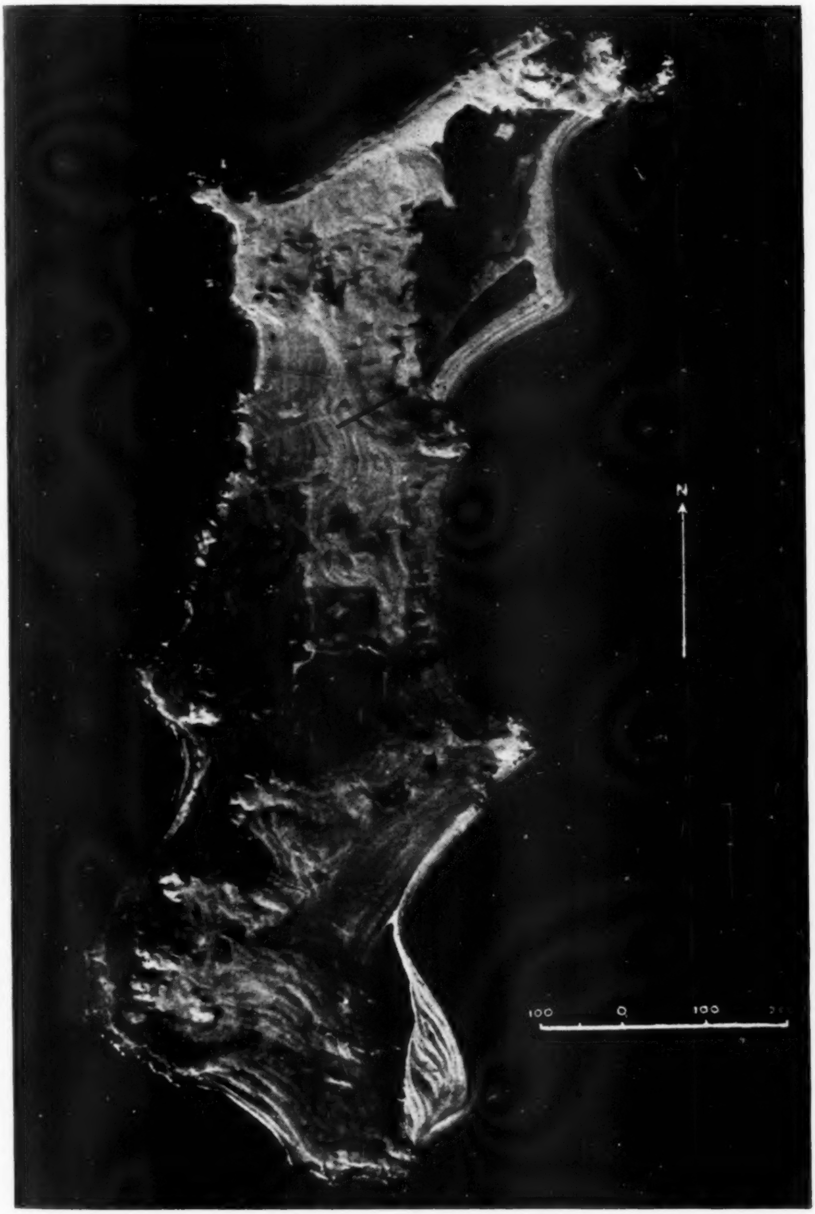

Fig. 4. Air photograph of Nordre Russøya showing the hut site (arrow) and its relation to the lagoon and shingle bar. (Photograph courtesy of the Royal Swedish Air Force, August 1957).

west coast of Vestspitsbergen. The first recorded wintering north of Prins Karls Forland was in 1770-71 (Conway 1906, p. 247), so that the Russians apparently made their way slowly up the west coast looking for new hunting grounds, and then they probably moved eastward along the north coast. In 1934 there was a Russian cross standing at Krosspynten on the west side of Wijdefjorden, and this cross had the date 1792 inscribed on it (Ingstad 1951, facing p. 80). There is no record of a migration up the east coast of Vestspitsbergen, but this may have occurred despite the ice conditions in Hinlopenstretet, which are often more severe than on the west coast.

On the west side of Nordre Russøya a cross still stands that was erected by Russian hunters (Figs. 2 and 6). These large crosses were set up in many places by the hunters, some of whom had been sent out by the monastery on Solovetskie Island in the White Sea. Although no inscriptions are now visible on this cross as a result of the effects of weather, and clawing and gnawing by polar bears, Carlheim-Gyllensköld (1900, p. 170) reported that in 1898 the date 1798 could be faintly seen about 1 metre above the base. Thus, if we discount the possibility that the hunters migrated up the east coast, this cross was almost certainly erected sometime between 1771 and 1798, but probably at the later date. It is very likely that the hut was built at the same time, because the hunters would have needed shelter.

Even if it is assumed, however, that the hut was not built until sometime after the cross was erected, it was standing and in good condition when the island was visited in 1861 (Nordenskiöld 1863, p. 7; Chydenius 1865, p. 164). *The minimum age for the hut, therefore, is 100 years.*

V. V. Frolov, former Director of the Arctic Institute in Leningrad, has stated that to his knowledge there is no record of Russian hunters in Spitsbergen after the 1850's (personal communication, December 1957). The last recorded Russian hunting expedition sailed from Arkhangelsk to Spitsbergen in 1851, wintered at Raudfjorden on the north coast, and left in the summer of 1852 (Erman's Archiv 1854, pp. 261-5; Duner, *et al.* 1867, pp. 101-2). One of the most interesting things in this expedition account, which first appeared in the *St. Petersburger Zeitung* (1853), is that the cargo being loaded on the ship in Arkhangelsk is described, and among the many articles was a quantity of wood for building houses (Erman's Archiv 1854, p. 262). It is evident that the Russians did not rely on finding driftwood, which is so abundant on Spitsbergen shores, but instead brought their own building materials with them.

In order to check the age of the hut a radiocarbon age determination on the outside wood of one of the base timbers was carried out by Dr. Ingrid Olsson at the University of Uppsala C-14 Laboratory. The age of this sample (No. U-37) is 260 ± 100 years (Olsson 1959, p. 91), and, as with all radiocarbon dates, there is a 68 per cent probability that the age of the wood is between the limits of error. To put it in another way, there is a 68 per cent probability that the tree was living sometime between 1600 and 1800, and this does not contradict the historical evidence that the hut was built sometime between 1771 and 1851.

Rate of land rise

Donner and West (1957, p. 17) of the 1955 Oxford University Expedition found driftwood, including some worked wood such as pieces of barrels and part of a boat, at nearly 10 metres above sea-level on the raised beaches of Brageneset, 30 kilometres southeast of Murchisonfjorden (Fig. 1). It should be noted, however, that these pieces of worked wood were not imbedded in the beaches, but were lying loosely on the surface (personal communication from J. J. Donner, August 1959). Donner and West suggested that the worked wood might have come from the 17th century whaling activity around Vestspitsbergen, and if so, it could not be much more than about 350 years old, which would mean that since then the land has been rising at a rate of nearly 3 metres per century in this area. The writer agrees with Donner and West that this would be a surprisingly rapid displacement of the shoreline and suggests that the land rise has been much slower.

Fig. 5. View north at the hut site on Nordre Russøya. The line of seaweed (arrow) on the inner side of the lagoon represents the highest tides and is 0.3 metres above mean sea-level and 0.8 metres below the hut. To the right is the shingle bar.

Driftwood and flotsam from many areas— the tropics, North America, Europe, and Siberia — have long been known in Spitsbergen (e.g., Agardh 1869, pp. 105-19; Nordenskiöld 1874, pp. 39-41; and Ingvarson 1903, pp. 65-8); there is no reason that the worked wood must have come solely from Vestspitsbergen. Furthermore, a possibility exists that some of the worked pieces were carried up by earlier visitors to Brageneset, as Donner and West themselves suggest for a barrel found at 17 metres. In fact Brageneset, or Hyperitön as it was formerly called, is the one other place in Nordaustlandet where a Russian hut once stood (Conway 1897, p. 260; 1906, p. 261).

Pumice, which probably originates in Iceland, has also long been known from raised beaches in Nordaustlandet. Donner and West (1957, p. 22),

however, were the first to show the importance of this pumice for correlating certain beach levels. They traced two horizons of the pumice along Hinlopenstretet and showed that the uplift of the land diminished northwestward from Brageneset. The upper pumice level (13.8 metres at Brageneset) was tentatively thought to be about 500 years old because of its relation to the driftwood. Interpolation from their diagram indicates uplift of the order of 1.5 metres per century at Nordre Russøya.

Recently Birkenmajer, a member of the Polish IGY Spitsbergen Expedition, has suggested in a series of publications that the presence of high-level whale bones, which he believes date from 17th century hunting, indicates relatively rapid uplift. He states (Birkenmajer 1958a, pp. 156-7; 1959, p. 199; 1960a, pp. 76-80) that the 17th-century bones of the Greenland or right whale *(Balaena mysticetus* L.) are found most commonly between 6 and 8 metres above sea-level in Hornsund, southern Vestspitsbergen, whereas the bones at lower altitudes, resulting from 19th century hunting, are those of the finback whale *(Balaenoptera physalus* (L.)) and the white whale (*Delphinapterus leucas* (Pall.)). Using observations on whale bones from a number of localities, Birkenmajer (1958b, p. 548; 1960a, p. 290) has constructed isobases of uplift for the whole of Spitsbergen, and after incorporating Donner and West's data on pumice he postulates an uplift of approximately 1 metre per century in the Nordre Russøya area. However, Jahn (1958, p. 240; 1959a, pp. 261-2; 1959b, pp. 171-6), a member of the same expedition, disagrees with Birkenmajer's results and states that uplift was rapid when the higher raised beaches in Hornsund were forming, but that little or no uplift is now occurring.

The writer has not worked in the Hornsund area, but he is convinced that all the high-level whale bones need not date from the 17th century, particularly those imbedded in the beaches. On the contrary, many are undoubtedly much older and are from whales that have died naturally and been washed ashore. In the innermost part of Lady Franklinfjorden whale bone imbedded in the beach at 17.6 metres has been dated by the Uppsala laboratory at 8530±180 years B.P. (organic fraction, sample No. U-115). Another piece of whale bone, from 7.5 metres in Murchisonfjorden, has been dated at 6380±150 years B.P. (organic fraction, sample No. U-110), and this sample was found with driftwood (No. U-107) dated at 6200±100 years B.P. (Olsson 1960, pp. 117-9). These two samples from Murchisonfjorden show good agreement and both are from the upper pumice level.

Conclusion

The evidence from the Russian hut on Nordre Russøya, which is at least 100 years old and is now only 1.2 metres above high-tide level and 0.8 metres above the highest tides, indicates that land uplift in this area is very slight, if it is occurring at all. An uplift of 1 metre or more per century would mean that this hut would have been under water when it was built! It seems most unlikely that a hut so near to the sea and in such an exposed

location would have been built in the first place if the water had been less than 1.2 metres below the hut site.

No long term observations on land rise are available from this area, but it appears that such a rise is measurable at most in terms of a few centimetres per century, not a metre or two. If a slow isostatic uplift of the land is occurring, it is certainly balanced by the present eustatic rise of sea-level.

Fig. 6. View east at the cross on Nordre Russøya, with the hut site in the distance (arrow).

This has been estimated at about 5 centimetres per century by Thorarinsson (1940, p. 151) on the basis of glacier shrinkage, and at 10 centimetres per century by Gutenberg (1941, pp. 721, 731) from his study of tide-gauge records. In Nordaustlandet, further evidence for the present stability of the shoreline exists in the extraordinarily well-developed shingle beach bars (Fig. 4), which are generally lacking at higher levels on the raised beaches.

Note added in proof: The figures 17.6 and 7.5 metres on page 108 should read 14.9 and 7.6 metres respectively. All other figures of altitude above mean sea-level should be reduced by 0.1.

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THE RUSSIAN SETTLEMENT AT RUSSEKEILA AND LAND RISE IN VESTSPITSBERGEN*

Hans Christiansson†

Introduction

The archeological-ethnographical expeditions to Vestspitsbergen in the summers of 1955 and 1960 were undertaken in order to investigate the possibility of settlements having existed in Spitsbergen before 1596, when the islands were "officially" discovered by the Dutch explorer Barents, and to search for traces of the many whaling and hunting stations that existed from the 17th to the 19th century (Conway 1906).

These inter-Nordic expeditions were organized by the writer, who also led the expeditions in the field, in 1955 together with P. Simonsen of Tromsø, Norway. Both expeditions were sponsored by the Tromsø Museum, and all collections have been deposited there. Preliminary reports of the 1955 expedition have been made by Christiansson (1956) and Simonsen (1957), and the reader is also referred to the reports in the "Polar Record" (1957, 1961). Shaskol'skiy (1958) has discussed the 1955 expedition from the Russian ethnographical point of view.

No detailed investigations of the many hunting stations have been made earlier, although isolated huts in Spitsbergen have often been mentioned and in a few cases described in the literature (e.g., Carlheim-Gyllensköld 1900, Norberg 1918). In connection with the main work of the expeditions some observations were made concerning the problem of land rise after deglaciation, and it is these observations that are the primary concern of the present report.

Excavations at Russekeila

Most of the work of the expeditions was carried out at Russekeila, an old Russian hunting station situated 3.5 kilometres northeast of Kapp Linné and about 100 metres east of the mouth of Linnéelva, on the south shore of Isfjorden (Figs. 1, 2, and 3). The excavations were made during July and August, 1955 and 1960, and many hunting implements, chess men, skinning tools, lamps, clay vessels, and barrel-making equipment were found, plus fine examples of handicraft in the form of carvings.

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* Translated from the Swedish by W. Blake, Jr.

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Among the objects in the ruins at Russekeila was a board with the date 1786 and some Russian letters carved on it, as well as a roof timber with the date 1778. Thus the ruins are known to date from the later part of the 18th century. It is probable, however, that the hunting station was there earlier, as no less than four different culture layers could be distinguished. The wood bearing the dates came from the uppermost layer, but there appear to be no great age differences between the four layers.

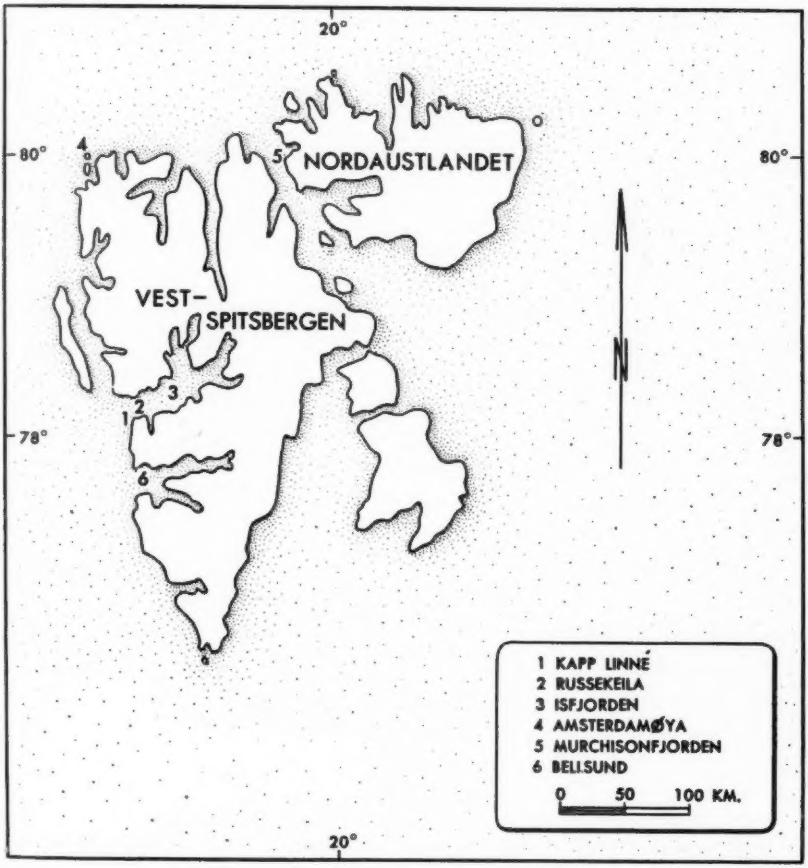

Fig. 1. Spitsbergen. (Base map by Orvin, 1940).

The Russekeila ruins lie near the edge of a flat vegetation-covered terrace, one of a series of gently sloping raised beaches (Figs. 2 and 3). The ruins are about 7 metres above sea-level at high tide according to observations made in August 1955 and August 1960, and the terrace edge slopes

steeply down toward a coarse gravel beach at the shore. On the side of the ruins facing Isfjorden there is a large kitchen midden. This is partly spread out on the surface of the terrace directly in front of the ruins, but most of it lies on the 4- to 5-metre-high steep slope of the terrace facing the shore. This midden has a maximum thickness of about 1 metre and is 30 metres wide near the top of the steep slope; at the foot of this slope it is only a few centimetres thick and about 6 metres wide (Figs. 3, 4, and 5).

Fig. 2. Detail of the ruins at Russekeila. Note kitchen midden (arrow) in front of the excavated Russian hut. View west.

The kitchen midden extends down so far that the water at high tide lies only 15 to 17 metres from its foot and 2 metres below it. The highest of the recent "storm beaches," in reality probably a result of sea ice shove, extends 1 to 2 metres up over the foot of the kitchen midden, covering it with a 30-centimetre-thick layer of gravel and cobbles.

As the Russians were not particularly active in this part of Spitsbergen much after 1826 and the last Russian expedition visited the islands in 1851-52 (Conway 1906, pp. 272, 275), it is probable that the kitchen midden has been undisturbed for over 100 years. The luxurious moss cover that has

overgrown the midden also indicates that it has not been added to for a long time, as such a moss cover takes a considerable time to develop. Rapp (1957, pp. 194-5) has shown, by comparing pictures taken in 1906 and 1954, that vegetation of the same type has not changed appreciably in nearly 50 years in the inner part of Isfjorden.

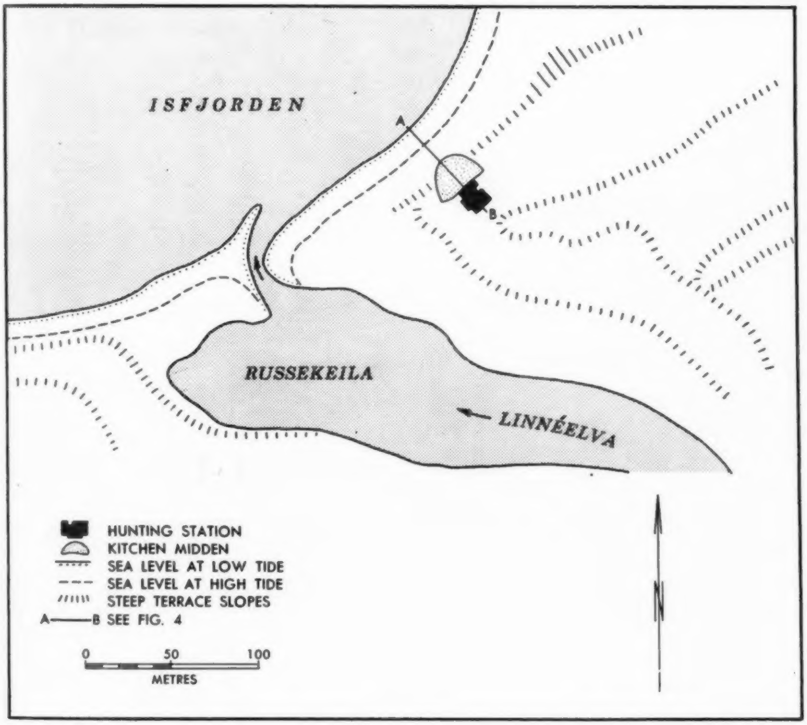

Fig. 3. Russekeila, Isfjorden. (Based on a map by H. Christiansson and P. Simonsen, August 1955).

Land rise

Since the kitchen midden is situated so that its undisturbed foot is only 15 to 17 metres from the sea and 2 metres above high-tide level, it is hardly possible that the land has risen appreciably in the last century. Birkenmajer (1960, p. 290) has suggested that the uplift in this area is approximately 2 metres per century, and if this were correct the foot of the kitchen midden would have been washed away by storm waves. However, the presence of

fresh, non-rounded bricks and unbroken bird bones in the lower part of the kitchen midden indicates that it has not been subject to wave action. Nor does the midden appear to have moved downhill through solifluction because (1) it is a very compact mass containing many artifacts, (2) it has a thick cover of moss, and (3) it is thicker at the top of the slope than at the bottom. Indeed, rather than a land rise it is more likely that a very slight sinking of the land has occurred since the end of the 18th century, but the evidence at present is inconclusive.

Fig. 4. The kitchen midden as seen from the shore (A-B, Fig. 3). In the foreground beach material covers the foot of the midden.

Similar evidence against a rise of the land is present in the northwest corner of Vestspitsbergen. In several places there are ovens for cooking whale blubber that were built by the Dutch in the 17th century. Vogt (1932, p. 563) postulated a sinking of the land because some of the ovens are now being washed into the sea, but more recently Feyling-Hanssen (1954, pp. 76-97) suggested that this apparent sinking was only due to erosion of the shore. However, as Feyling-Hanssen's detailed profiles show, many of the ovens are now only 1 metre above sea-level. They could not have been built any lower, and even if a sinking of the land may not have taken place, at least there has been no uplift in the last 300 to 350 years.

It is probable that archeological investigations in Spitsbergen, which are planned as a long term project and which, it is hoped, will include

radiocarbon dating of material from different old settlements, will provide more details concerning the postglacial emergence of the land. Although there are not yet enough data to show that the entire Spitsbergen region has behaved in the same way isostatically during the last few hundred years, the evidence from the Russian hut in Murchisonfjorden (Blake 1961), from the whale oil ovens on Amsterdamøya and elsewhere in northwestern Vestspitsbergen, and from the Russian settlement at Russekeila in Isfjorden is the same. *In these areas there has been no appreciable land rise in at least 100 years,* and on Amsterdamøya at least, no significant change in the relation between land and sea has occurred for over three centuries.

Fig. 5. View northeast along the shore of Isfjorden. In the foreground (arrow) the lowest part of the kitchen midden is overlain by beach material.

Acknowledgments

The writer expresses his thanks to all members of both expeditions for assistance in the field, especially M. Müller-Wille, P. Manecke, and L. Florin for the excavation of the kitchen midden and mapping during the summer of 1960. Financial support for the expeditions was generously

provided by: (1) from Norway — Norges Almenvitenskapelige Forskningsråd; (2) from Sweden — Statens Humanistiska Forskningsråd, Längmanska Kulturfonden, and Letterstedtska Föreningen; and (3) from Finland — Nordenskiöldsamfundet. Norsk Polarinstitutt and Tromsø Museum helped the expeditions in many ways, and a number of private firms kindly donated food and equipment. Appreciation is expressed to W. Blake, Jr. for undertaking the translation and for critical reading and discussion.

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NOTES

SALMON INVESTIGATIONS ON THE WHALE RIVER, UNGAVA IN 1960 AND THE DEVELOPMENT OF AN ESKIMO FISHERY FOR SALMON IN UNGAVA BAY

A study of the Atlantic salmon populations breeding in the Ungava Bay watershed, which commenced in 1956 on the George River and in 1957 on the Koksoak River, was continued during the summer of 1960 on the Whale River. The two principal collecting stations were at the site of the old Hudson's Bay Company's post, in tidal waters, and in a rapid section of the river 15 miles above the post, in non-tidal waters.

In spite of a very wet summer, which resulted in high water levels all season, a good sample of salmon was obtained. Almost 900 specimens were examined, of which 185 were adults that had entered the river to spawn, 32 were spent fish from the run of the previous year, and the rest were juvenile smolts and parr. Most of the large fish were captured in gill nets of 4-, 6-, and 8-inch mesh, about one-half of the juveniles were taken in 1.5-inch-mesh gill nets, and the remainder by angling. The spawning run in Whale River began about August 6 and continued until the end of the month, when catches at the post fell to almost nothing. The 1960 run in the Koksoak River followed a similar pattern. Whale River salmon were the same size as those examined from other Ungava rivers. The majority are between 9 and 13 lbs. in weight and have spent 2 years or longer feeding at sea. The grilse, after 1 or more years at sea, are between 3.5 and 6 lbs. in weight. Analysis of the data on the juveniles is not yet complete, but indicates a growth and age range similar to that found previously in the George and Koksoak rivers, that is, they migrate to the sea when they are 3 to 7 years old and between 18 and 26 cms. long.

In addition to the work on the salmon, specimens and data were collected of other species of fish inhabiting the river. Fourteen species were recorded, all of which have been previously collected from the Ungava Bay drainage. Specimens of most of these species were deposited in the collection of the Royal Ontario Museum. Mr. Malcolm Telford, who assisted the writer during the summer, began a study of the round whitefish *Prosopium cylindraceum,* but was unfortunately hampered by shortage of specimens.

The information that has been accumulated during this series of investigations on Ungava salmon is now proving to be of practical importance. During the summer of 1961 the Department of Northern Affairs and National Resources plans to initiate an experimental Eskimo fishery for salmon on the Koksoak River and possibly also on the Whale River. Fresh salmon are to be flown from Chimo to Montreal for sale. It has been possible to provide the Department with information on desirable mesh sizes for the nets and on the probable weight distribution of the catch.

By continuing to collect data during the course of the fishing and following closely any changes in the composition of the catch it will be possible to find out whether the expected fishing pressure (removal of 10,000 lbs. of fish per river per year) is having any effect on the population. In this way it can be discovered whether the salmon inhabiting these northern waters can maintain themselves against both the physical handicap of their environment and the stress of fishing. The scanty and probably unreliable evidence from the

records of the Hudson's Bay Company fishery started in the 1880's and abandoned in the 1930's indicates that catches may decline after a period of fishing. It is hoped that by employing university students to assist with the project accurate records can be obtained of the size and age composition of the catches and that a careful watch can be maintained on any effects of the planned fishery.

I should like to thank both the Arctic Institute of North America and the Provincial Department of Fisheries of Quebec for the financial support that made this work possible.

G. POWER

Fig. 1. Sketch map showing the newly discovered Rennick Glacier flowing into Rennick Bay, Victoria Land.

TWO RECENTLY DISCOVERED GLACIERS, ANTARCTICA

The purpose of this paper is to make available preliminary information on two recently discovered glaciers in Victoria Land, Antarctica.

As a continuation of the International Geophysical Year scientific effort in Antarctica, two ground traverses were organized by the United States Antarctic Research Program and administered by the Arctic Institute of North America. The first of these traverses left Scott Base on October 16, 1959 in three tracked Sno-Cats, traversing parts of

the Ross Ice Shelf, the Skelton Glacier, Victoria Land, and Wilkes Land.

During the aerial evacuation of the traverse group, consisting of F. G. vander Hoeven, A. W. Stuart, A. J. Heine, W. M. Smith, L. J. Roberts, T. Baldwin, A. R. Taylor, W. A. Jackman, C. Lorius, and J. G. Weihaupt, early in 1960, an aerial photo reconnaissance was made from 72°38.0′S-161°31.8′E. to Rennick Bay on the Oates Coast of the Antarctic Continent. During the reconnaissance, a new and sizeable glacier was discovered that terminates in the vicinity of Rennick Bay. During an earlier photo reconnaissance a second and smaller glacier was discovered flowing east, terminating in the vicinity of Lady Newnes Ice Shelf in the Ross Sea [1, 2].

fined mountains to the east. The most prominent of the tributaries enters from the southeast in the area of 72°00′S. 160°30′E. and is perhaps 8 km. in width. The width of the main glacier varies from 50 to 80 km., the broadest area occurring at 72°00′S., where it assumes the appearance of a broad, relatively flat ice-filled valley.

On the west, the glacier is bounded by relatively low lying and widely spaced mountains and nunataks, that separate it from the Victoria Land Plateau proper, thereby defining an irregular limit on that side of the glacier. These mountains appear to be geologically different from those found on the eastern side (Fig. 2.), where the glacier is sharply delineated in a comparatively straight north-south line. The mountains there

Fig. 2. View over Rennick Glacier. Eastern limit is defined by prominent mountains, background. (U.S. Navy photo).

Rennick Glacier [3]

The head of the Rennick Glacier is believed to be located slightly south of the last station occupied by the Victoria Land ground party at 72°38.0′S 161°31.8′E. Although the party was unable to continue south of this point, due to the lateness of the season, the glacier appeared to the naked eye to continue at least 50 km. in that direction, indicating a minimum length of 260 km. (Fig. 1.) Many tributary glaciers were noted, the more distinguishable ones entering the main valley from high, well de-

are higher, they rise directly out of the glacial valley and occupy a large region east of the glacier, whereas the western line of mountains is interspersed with broader tributary glaciers. In the area of 71°50′S. a large nunatak temporarily divides the glacier as it flows north. This feature appears to be geologically similar to the mountains east of the glacier. To the south and southeast the mountains are sedimentary, whereas metasedimentary types were seen on ground examination of exposures on the west side of the glacier near 72°00′S.

A prominent altitude drop takes place at 72°00′S. as the glacier moves toward the coast (Fig. 3). Between 72°00′S. and 71°30′S., a distance of 55.5 km., the altitude decreases 1250 m. as indicated by aircraft altimetry. As this type of measurement is subject to some error, the true figure may be slightly more conservative, although there is no question of a major altitude change in this area. The maximum altitude of the glacier is probably in the range of 1500 to 2000 m., except near its western lateral limits where it fuses with the Victoria Land Plateau, which rises to over 2300 m. near the upper limits of the glacier. Near 71°20′S. the surface of the glacier approaches sea-level, maintaining this general altitude to the coast.

glaciers, as indicated in Fig. 1 are based on sketches, done during the reconnaissance flight, that have been used in conjunction with 58 overlapping, oblique aerial photographs. The resulting outlines and positions of these features are approximate, although the scale and general outline are believed to be reasonably close. As the flight run originated over a position fixed by solar observation, it is believed that the plot for the seaward end of Rennick Glacier is more nearly correct than that inferred from existing maps.

Lady Newnes Glacier[3]

Lady Newnes Glacier, although reasonably well fixed, is not as well defined

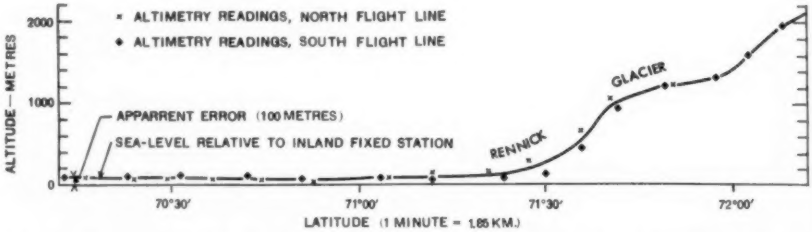

Fig. 3. Cross-section of Rennick Glacier (looking east), showing altitude profile as determined from aircraft altimetry.

The comparative volumes of ice contributed by either side could not be accurately estimated at the time of the reconnaissance, although that contributed from the western side, and therefore from the Victoria Land Plateau, is in the form of broad, less distinct glaciers, suggesting a greater supply from that source.

On reaching the coast the aircraft flight line as plotted did not coincide with the center of Rennick Bay on exising maps, although the aircraft was over the center of the bay. Fig. 1 shows the configuration and location of Rennick Glacier and its terminus in Rennick Bay, indicating a substantially larger mouth than was previously thought. It is important here to point out that the lateral limits of the glacier, including tributary

as the Rennick Glacier and is smaller in extent. It was observed only briefly and neither sketches nor usable photographs are available. Its origin is believed to be in the area of 73°S. 163°E. from which it flows to a point around 73°21′S. 165°00′E., then into the Lady Newnes Ice Shelf, its lower limits passing between Mount Muchison and Mount Monteagle. Its total length is estimated to be 115 km.

Whereas the Lady Newnes Glacier was observed flowing east to the Ross Sea, the upper limits of the Priestley Glacier were reported by the pilot to extend north from the Priestley's terminus in the area of the foot of the Reeves Glacier, to approximately 73°30′S. 163°15′E. near the origin of the Lady Newnes Glacier. This suggests a common general

area of origin for the Lady Newnes, Priestley, and Rennick Glaciers.

The author appreciates aerial photographs made available by the U. S. Navy for this report. Thanks are extended to Lt. Commander Dale, pilot of the aircraft and to the VX-6 Squadron of Task Force 43, whose initiative is responsible for the discovery of these features.

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[1]Klimov, L. B., and Solovyev, D. S. 1960. Correlation of geological formations of the shore of Ross Sea and Oates Coast. Inform. Bull. of the Soviet Antarctic Expedition No. 16, 1960.

[2]Weihaupt, J. G. 1960. Reconnaissance of a Newly Discovered Area of Mountains, Antarctica. J. Geol. 68:669-73.

[3]Suggested name for the newly discovered glacier, not yet approved by the Board on Geographic Names.

INSTITUTE NEWS

The Institute Library: annual report for 1960

The past year has been one of continued growth and service.

The Library now contains 4470 bound volumes, 589 having been added during the past year; 517 reprints and pamphlets were received and 1937 periodicals; 357 serials are currently being received regularly; 186 volumes were bound or rebound.

The public catalogue had 5876 cards added to it, this was almost twice as many as last year and brings the total to 30,488 cards; 1106 cards were sent to the Union Catalogue of the National Library in Ottawa, and 1265 publications were catalogued — 26 per cent more than in the previous year.

With the ever increasing interest in the polar regions the resources of the Library are being called upon more and more to help in solving problems of great variety. Though no count is kept of the reference questions dealt with in the Library, a substantial and increasing amount of the time of the librarian is spent in tracking down information for the Institute staff, university students, authors of polar books, companies, and people who are "interested in the North".

Although material on all arctic subjects and regions is being collected, particular efforts are being made to increase the holdings of Russian material. It has been possible to enter into exchange agreements with 11 Russian agencies, who send regularly 23 Russian serials and almost one-quarter of the total number of volumes received were published in Russia. *Arctic* is sent on exchange to libraries and polar institutes in Argentina, Australia, Belgium, Denmark, France, Germany, Italy, Norway, United Kingdom, and United States of America, as well as to libraries in Brazil, Finland, Greenland, Iceland, Japan, Mexico, New Zealand, Poland, Spain, Sweden, Switzerland, Union of South Africa, and Yugoslavia.

Early in February a general meeting of the Quebec Library Association was held in the Institute. Mr. Gordon Lowther of the McCord Museum, McGill University, spoke to the members on the history of archaeological research in the North American Arctic.

In June a joint meeting of the Canadian Library Association and the American Library Association was held in Montreal. The Institute's Library was one of the two special libraries listed in the ALA's program as being of interest.

Many librarians availed themselves of the opportunity to visit it. The Librarian was very pleased to be able to explain the Institute's work, and to bring the resources of the Library to their notice. Miss Marie Tremaine, editor of the Arctic Bibliography, was in Montreal at that time to address the Bibliographical Society of Canada on the subject of the Institute's Bibliography Project, and the Institute and its Library. As a result many of the members of her audience visited the Library.

Complimentary copies of the following serial publications have been gratefully received during the past year:

Actividad antártica argentina

Alaska University. Biological Papers

Alaska University. Arctic Research Laboratory. Progress Report

Alaska University. Geophysics Institute. Contributions Series A, Series B, Geophysics Research Reports, Scientific Reports

Alaska Agricultural Experiment Station. Circulars, Progress Reports

Alaska Historical Library and Museum. Biennial Report of Progress and Condition

Alaska Resource Development Board. Alaska Passenger Traffic Survey, Biennial Report, Estimates of Alaska Population, Financial Data . . . Towns and Cities of Alaska

Antarctic Record — Reports of the Japanese Antarctic Research Expedition, 1956-57

Arctic Summary

Arktisk Institut. Danish Scientific Activities in Greenland

British Glaciological Society, Glaciological Research Sub-Committee. Technical Notes

Building Research in Canada

Canada Defence Research Board. Technical Translations, Translations from the Japanese, Russian, and Spanish

Canada Defence Research Northern Laboratory. Technical Memorandum

Canada Department of Northern Affairs and National Resources. Annual Report

Canada Department of Northern Affairs and National Resources. Editorial and Information Division. Release

Canada Department of Northern Affairs and National Resources. Water Resources Branch. Water Resources Papers

Canada Department of Transport. Navigation Conditions on the Hudson Bay Route, Annual Report

Canada Department of Transport. Meteorological Branch, Monthly Weather Map, Monthly Radiation Summary.

Canada National Research Council. Technical Memorandum, Technical Papers, Technical Translations

Canada National Research Council. Associate Committee on Soil and Snow Mechanics. Annual Report, Proceedings

Canada National Research Council. Division of Building Research. Canadian Building Abstracts, Research Papers

Canadian Geophysical Bulletin

C.I.L. Oval

Falkland Islands and Dependencies, Meteorological Service. Annual Meteorological Tables

Finlandia Pictorial

France. Comité national français des recherches antarctiques. Circulaire

From the Nation's Capital . . . Ernest Gruening

Geophysica — Meteorology

Geophysical Research in Norway

Glaciological Notes

Great Britain. Ministry of Agriculture, Fisheries and Food, Fisheries Laboratory. Hydrographical Observations (RV Ernest Holt)

Greenland. Chief Medical Officer. Annual Report, State of Health in Greenland

Greenland. Tekniske Organisation. Publication

High Latitude Geophysical Data

Hudson's Bay Record Society. Publications

Ice Cap News

Information on Soviet Bloc International Geophysical Cooperation

International Commission for the Northwest Atlantic Fisheries. Annual Proceedings, Statistical Bulletin

International Geographical Union,

Commission de gémorphologie appliquée. Circulaire
IGY Aurora (Instrumental) Report
IGY Auroral Data Centre A. U.S. Visual Observations
IGY Bulletin
IGY General Report Series
IGY Oceanographic Report
IGY Rocket Report Series
International North Pacific Fisheries Commission. Annual Report, Bulletin
International Union of Geodsy and Geophysics. Chronicle, Supplément bibliographique, Newsletter
Inuktiut
J. L. News
McGill Sub-Arctic Research Papers
McGill University, Arctic Meteorology Research Group. Publications in Meteorology
McGill University, Sub-Arctic Research Laboratory. Summary of Climatological Data
Münchner Geographische Hefte
Nalunaerutit Serie A, B
National Academy of Sciences, Committee on Polar Research. Arctic Status Report
National Bank of Iceland, Reykjavik. Statistical Bulletin
National Museum of Canada. Bulletin
National Science Foundation, U.S. Antarctic Research Program. Antarctic Status Reports
Newfoundland Department of Mines and Resources. Annual Report
Northern Canada Power Commission. Annual Report
Northwest Territories. Ordinances
Norwegian-British-Swedish Antarctic Expedition. Scientific Results
Operation Hazen 1957-58. Reports
Polar Notes
Quebec (Province) Department of Mines, Geological Surveys Branch. Preliminary Reports
The Roundel
Royal Bank of Canada. Monthly Newsletter
Royal Canadian Mounted Police. Reports
Russian Technical Literature
Sapporo, Japan. Hokkaido Imperial University, Faculty of Science. Journal
SCAN: A Monthly Bulletin
Screenings from the Soil Research Laboratory
Service de biogéographie. Bulletin
Sierra Club Bulletin
Sociedad geográfica de Colombia. Boletín
Sociedad geográphica de Lima. Boletín
Soviet News Bulletin
Swiss Foundation for Alpine Research. Journal
Trans-Antarctic Expedition 1955-1958. Scientific Reports
Tokyo University of Fisheries. Journal (Special Edition)
U.S.S.R. Illustrated News
U.S. Air Force, Arctic Aeromedical Laboratory. Technical Notes
U.S. Antarctic Projects Officer. Bulletin
U.S. Antarctic Research Program Antarctic Status Report
U.S. Army, Polar Research and Development Center. Reports
U.S. Department of Commerce, Office of Technical Services. Information on Soviet Bloc International Geophysical Cooperation — 1960
U.S. Hydrographic Office. Technical Reports
U.S. Quartermaster Corps, Environmental Protection Research Division. Research Study Reports, Technical Reports
Les variations des glaciers suisses
Ward Index of Consumer Prices in . . . Alaskan Cities
Washington Newsletter
Wildlife Management Bulletin — Series 1, 2, 3.
Yukon Territory. Ordinances

NORA T. CORLEY, B.A., B.L.S.
Librarian

Gifts to the Library

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Air Force arctic planning session

The third Air Force annual planning session was held at the University Club in Boston, Mass., on November 28, 29, and 30, 1960. It was conducted by the Arctic Institute with Dr. G. P. Rigsby as general chairman.

The conference was opened by Col. E. A. Pinson, Director of the Geophysics Research Directorate of Air Force Cambridge Research Laboratories who delivered an address of welcome. Col. L. DeGoes, Chief, Terrestrial Sciences Laboratory of G.R.D. then presented a review of research done by the Air Force, which was followed by the main address by Dr. J. C. Reed, Executive Director of the Arctic Institute.

The afternoon of the 28th was devoted to research on ice-free land, with talks by Wm. B. Davies, S. M. Needleman, and Major T. D. N. Douthit, which stimulated animated discussions. Mr. Needleman was chairman of the session.

Ice shelves and ice islands was the topic on Tuesday morning, with Dr. J. Lyons presiding. Talks were given by Dr. Lyons, F. Crowley, R. B. Sagar, and G. Cabaniss. The chairman directed the discussions.

The Tuesday afternoon session on research in the Arctic Ocean was led by Miss Vivian Bushnell. Talks were given by Dr. K. Hunkins, Dr. Joost Businger, J. G. Dyer, and Miss Bushnell. The last hour of the afternoon was devoted to research on arctic lakes, with a talk by Dr. F. Barnes, followed by discussion.

The Wednesday morning session on engineering properties of ice was led by C. E. Molineux. Mr. Molineux, Dr. W. D. Kingery, Dr. C. M. Adams, E. Moser, Dr. W. F. Weeks, and Capt. Donald W. Klick presented papers, which were followed, by discussions under Mr. Molineux's direction.

The final session on Wednesday afternoon was devoted to a panel discussion on arctic research. Dr. G. P. Rigsby served as moderator. Panel members were Dr. A. Assur, Dr. H. Bader, Wm. E. Davies, Wm. O. Field, Drs. G. Hattersley-Smith, G. Kiersch, W. D. Kingery, W. K. Lyon, J. B. Lyons, J. E. Oliver, S. Orvig, E. R. Pounder, J. C. Reed, W. F. Weeks, and A. L. Washburn. Dr. Bader, the first speaker, gave a stimulating talk on "the problem of arctic research", which provoked a lively discussion that lasted for about 3 hours with only a short coffee break.

The entire session was very stimulating, and many fresh ideas resulted from the panel discussions.

GEORGE P. RIGSBY

Antarctic orientation

For the third year the Institute is going to plan and manage an orientation session for all members of the U.S. Antarctic Research Program. Sessions with lectures and discussions and training courses have been held in mid-September at a mountain lodge in the Shenandoah National Park, 90 miles from Washington, but a site for 1961 has not yet been chosen. About two hundred scientists and technicians, who will be leaving for Antarctica between October and December, will learn about the results of past research and hear discussions of the programs for 1961-2 by senior scientists. The participants who are going to work in mountainous areas in geology and geophysics will receive instruction in mountaineering and safety techniques.

The Institute administers this program under contract to the National Science Foundation.

Third annual program in Washington

Over three hundred members and invited guests of the Institute enjoyed an evening of talks and refreshments on April 12 in the auditorium of the Carnegie Institute of Washington.

Speakers on subjects relating to the Arctic Slope of Alaska were Max C. Brewer, Director of the Arctic Research Laboratory, Dr. Arthur Lachenbruch of the U.S. Geological Survey, Menlo Park, Calif., and Prof. John M. Campbell of George Washington University. Topics discussed by the respective speakers were "The program of the Arctic Research Laboratory", "Permafrost and the landscape", and "Problems in the study of man on the Arctic Slope". Dr. John C. Reed acted as chairman of the meeting.

Appointment of Mr. G. R. Parkin

The Institute has appointed Mr. G. Raleigh Parkin, until recently an Associate Treasurer of the Sun Life Assurance Company of Canada at their head office in Montreal, as Assistant to the Executive Director. Mr. Parkin, who was one of the founders of the Institute in 1945, will be chiefly concerned with the development aspects of the Institute.

Mr. Parkin, son of the late Sir George Parkin, Organizing Secretary and first administrator of the Rhodes Scholarship Trust, was born at Upper Canada College, Toronto. He was educated at Winchester College, England, the Royal Military College of Canada, Kingston, and at Balliol College, Oxford, where he took an honours degree in Modern History. After active service in World War One with the British and Canadian armies and following graduation at Oxford University he returned to Canada in 1922 and joined the Investment Department of the Sun Life Assurance Company of Canada in Montreal, where he was concerned with the Company's investment operations in Commonwealth and foreign countries.

Mr. Parkin is a member of the Canadian Political Science Association and the Canadian Institute of International Affairs and has been a member of the latter's National Research Committee. He has also served for many years as a trustee of the Institute of Current World Affairs, an American foundation with headquarters in New York, endowed by the late Charles R. Crane of Chicago, whose primary aim has been the development of area generalists through the award of travelling fellowships.

Award of Institute Grants

The following have been awarded research grants by the Institute for 1960 from the Sir Frederick Banting Fund, funds of the Institute and through contract with the United States Office of Naval Research:

ADAMS, WM. P. McGill University, Montreal P.Q., Canada.
Rates and modes of runoff and ablation and the relationship between the two. Axel Heiberg Island, N.W.T., Canada.

BESCHEL, R. E. Queen's University, Kingston, Ont., Canada.
Glaciological, lichenometrical, and plant succession studies on Disko Island and Nugssuaq Peninsula, West Greenland.

CHANCE, N. A. University of Oklahoma, Norman, Okla., U.S.A.
Arctic studies in culture change and mental health. Barter Island, Alaska, U.S.A.

DUGDALE, R. C. University of Pittsburgh, Pittsburgh, Pa., U.S.A.
A continuing investigation of the phosphorus and nitrogen cycles of arctic and subarctic lakes. Aleutian Islands, Alaska, U.S.A.

FOLK, JR., G. E. State University of Iowa, Iowa City, Iowa, U.S.A.
Twenty-four-hour physiological rhythms in arctic animals in continuous daylight. Barrow, Alaska, U.S.A.

FREY, D. G. Indiana University, Bloomington, Ind., U.S.A.
Limnology of Peters and Schrader lakes and life cycle adaptation of arctic Cladocera. Lake Peters and Barrow, Alaska, U.S.A.

HANSON, H. C. Illinois Natural History Survey, Urbana, Ill., U.S.A.
A low-level aerial reconnaissance of the Hudson Bay Lowlands, Hudson Bay Lowlands, Canada.

HARP, JR., E. Dartmouth College, Hanover, N.H., U.S.A.
Intensive archaeological investigations in a major complex of sites of the Dorset Eskimo culture. Newfoundland, Canada.

HEDBERG, O. University of Uppsala, Uppsala, Sweden.
Determination of chromosome numbers of vascular plants of arctic North America. Uppsala, Sweden.

HOLMQUIST, CH. M. Lunds Universitet, Lund, Sweden.
Arctic relatives of the so-called marine-glacial relicts, Friday Harbor. Washington, D.C. and Barrow, Alaska, U.S.A.

HULTÉN, E. Riksmuseum, Stockholm, Sweden.
Field studies of certain groups in the arctic flora. Barrow, Alaska, U.S.A.

HUME, J. D. Tufts University, Medford, Mass., U.S.A.
Sediment transportation in the vicinity of Barrow, Alaska. Barrow, Alaska, U.S.A.

HUSSEY, K. M. Iowa State University, Ames, Iowa, U.S.A.
Further investigations into the physical and chemical properties of the permafrost and the geomorphogeny of some arctic relief features. Barrow, Alaska, U.S.A.

JACKSON, C. I. London School of Economics and Political Science, London, England.
An investigation of the wind field in the lower troposphere by pilot balloon observations. Ellesmere Island, N.W.T., Canada.

KORANDA, J. J. Alaska Agricultural Experiment Station, University of Alaska, Palmer, Alaska, U.S.A.
Experimental taxonomic studies of arctic ecotypes of Alaskan grasses and legumes and an evaluation of their variability. Barrow and Palmer, Alaska, U.S.A.

KREBS, CH. J. University of British Columbia, Vancouver, B.C., Canada.
Comparative population dynamics of the varying lemming and the brown lemming in relation to three current hypotheses concerning northern microtine cycles. Baker Lake, N.W.T., Canada.

MCPHAIL, J. D. McGill University, Montreal, P.Q., Canada.
A study of the post-glacial dispersal of freshwater fishes into northern North America. Various museums.

MOHR, J. L. University of Southern California, Los Angeles, Calif., U.S.A.
Biology of the right, grey, and white whales in arctic Alaskan waters. Barrow, Alaska, U.S.A.

MOSS, M. L. Columbia University, New York, N.Y., U.S.A.
Skeletal analysis of arctic fish. Barrow, Alaska, U.S.A.

MÜLLER, F. McGill University, Montreal, P.Q., Canada.
A study of ice movement in the marginal zone of a polar glacier with special reference to the problem of

glacial erosion. Axel Heiberg Island, N.W.T., Canada.

PESSL, JR., F. University of Michigan, Ann Arbor, Mich., U.S.A.
Studies in geomorphology and glacial geology. Sortehjorne, Greenland.

PITELKA, F. A. University of California, Berkeley, Calif., U.S.A.
Comparative ecology of lemmings and other microtines in northern Alaska. Barrow, Alaska, U.S.A.

REED, B. L. Harvard University, Cambridge, Mass., U.S.A.
Bedrock geology of a part of the Lake Peters area, Alaska. Lake Peters, Alaska, U.S.A.

SATER, J. E. Arctic Institute of North America, Washington, D.C., U.S.A.
Acquisition of material for developing photogrammetric and photo-interpretative techniques for the evaluating of the surface morphology of sea ice. Barrow, Alaska, U.S.A.

SMILEY, Ch. J. Macalester College, St. Paul, Minn., U.S.A.
Crataceous floras of Kuk River, Alaska. Kuk River, Alaska, U.S.A.

SOLECKI, R. S. Columbia University, New York, N.Y., U.S.A.
Archaeology and ecology of northeastern Alaska. Arctic Slope, Alaska, U.S.A.

STEERE, WM. C. New York Botanical Garden, New York, N.Y., U.S.A.
A critical field study of arctic American mosses. Barrow, Alaska, U.S.A.

TEDROW, J. C. F. Rutgers University, New Brunswick, N.J., U.S.A.
A study of the pedologic processes operating in the arctic areas of Alaska. Brooks Range, Alaska, U.S.A.

WILIMOVSKY, N. J. University of British Columbia, Vancouver, B.C., Canada.
An ichthyological survey of the Aleutian Islands. Aleutian Islands, Alaska, U.S.A.

REVIEWS

LA FRANCE ET L'EXPLORATION POLAIRE. DE VERRAZANO À LA PEROUSE. 1523-1788.

By MARTHE EMMANUEL. *Paris: Nouvelles Editions Latines. 1959. 9 x 5½ inches, 397 pages, maps, plates. No price.*

For anyone interested in polar exploration and able to read French this is a most fascinating book, the more so because it is written from a point of view different from any to which most of us in North America are accustomed — that of a Frenchwoman setting out expressly to examine French participation in the field. It thus has for us a freshness and stimulation over and above its very considerable intrinsic merits, and the result is a book that is indispensable to any well-stocked polar library.

Most of us would raise a polite eyebrow and wonder how the story of French exploration in the Arctic and Antarctic could fill nearly 400 pages and get no farther than 1788. Dr. Emmanuel herself is the first to raise this question, in the opening sentence of her introduction, and the first to admit that the contribution of France does not compare with those of many other countries. Nevertheless many will be surprised at the extent of the effort and achievement that she reveals, an achievement all too often nullified by apathy and lack of government support at home, and by the obstinate refusal of the armchair geographers to believe the reports brought home by explorers. For example, every child knows about Raleigh and the founding of Virginia, but how many know that half a century before Raleigh the Italian Verrazano, sailing under French colours, traced the coast of North America from Spanish Florida

north to Labrador and gave it the name of Francesca? If the French government had followed this voyage with colonization, it is possible that the United States and Canada might today be one large united French-speaking territory.

As will be seen from the above example, Dr. Emmanuel does not limit herself strictly to polar exploration. Yet she never loses sight of her subject. All the voyages she discusses are directly connected with what turned out to be polar objectives, such as the Northwest Passage (Verrazano, the explorers of New France, La Pérouse) or the elusive Terra Australis (Bouvet, Marion du Fresne, Kerguelen) and contribute quite legitimately to the overall picture. The book is divided into two almost equal parts dealing with the Arctic and Antarctic respectively. Quite a large section is devoted to the Spitsbergen whaling days, and here the French played a very important part, as all the other nations, Dutch, English and Danish alike, were dependent on the hardy Basque harpooners of the Biscay fisheries to teach them the art. It was also the French who later were the first to process whales on board ship and thus do away with the necessity for a shore station.

It must not be thought because the book deals specifically with the French contribution that it is chauvinistic in tone. The author's attitude is occasionally partisan, but on the whole she takes a very detached and objective view of her countrymen, and while she presents much little-known material that will greatly enhance the importance of their role in the eyes of those hitherto unfamiliar with it, the claims she makes on their behalf are modest. And if she is outspoken about the English tendency to take possession of territories on claims that appeared groundless to all but themselves, the point must be admitted to be well taken, and it is salutory for those of us who are of British extraction to be reminded of it from time to time. This regrettable propensity at least showed a willingness on the part of the home government to take action and to support claims to discovery, however tenuous. Dr. Emmanuel's book gives repeated instances of the opposite attitude in France — apathy and unwillingness to follow up discoveries or even to publish the results of voyages till years later if at all, so that in many cases it was hardly surprising that French names were replaced on the maps by those of later explorers, from Verrazano's Francesca right down to the names chosen by La Pérouse on his fine survey of the coast of Southern Alaska.

The academic or armchair geographers come in for considerable criticism. It is interesting to speculate on the reasons for the obstinate refusal of so many of these men to abandon, in the face of the most conclusive evidence, such long-cherished chimeras as the great southern continent and the strait of Juan de Fuca and Admiral de Fonte, which was supposed to join Hudson Bay to the west coast, and on the extent to which they retarded geographical knowledge by this refusal. Such men were to be found everywhere, and France had a whole family of them — the brothers Delisle and their in-laws and descendants, the Buaches, who even after Cook's last voyage were still talking to La Pérouse of de Fuca and de Fonte. An interesting exception was the great naturalist Buffon, who was a strong supporter of the southern continent and of the open polar sea theory, but unlike Buache altered his thinking after the voyages of Cook and Phipps.

Of particular interest to Canadians is the section on Canada and the struggle for Hudson Bay. Here again we see the British solidly backed up at home and the poor French left in the lurch at every turn. It was not love of the British that led Radisson and de Groseilliers to defect, but sheer frustration at their treatment by the French Government. It is remarkable indeed that there were not more like them, and even more remarkable that the French made the tremendous achievements they did in the New World. Perhaps it was just this lack of encouragement and unwillingness to provide sufficient support that first taught the French in Canada to manage without and to adapt themselves so well to the Indian ways of travelling.

With a minimum of material assistance they travelled overland to Hudson Bay, the Prairies, and the Gulf of Mexico, and would no doubt soon have reached the Pacific, as Dr. Emmanuel points out, had it not been for the intervention of the Seven Years War in 1754. As it was, French *coureurs de bois* rendered indispensable assistance to those who did.

An interesting point is brought out in connection with La Pérouse's voyage to Hudson Bay in 1782 and the taking of Fort Prince of Wales. Among the effects of Samuel Hearne, governor of the fort at the time, La Pérouse found the journal of his journey to the Coppermine, hitherto unpublished and indeed, according to this author, deliberately kept secret by the Hudson's Bay Company. La Pérouse wanted to confiscate it as Company property, but Hearne insisted it was his own, and was allowed to keep it on condition that he would publish it as soon as he got back to England. It was in fact not published until 1795, which was deplored by the French, and rightly if the story is accurate, as a breach of faith. Had it been published immediately on his return from the Coppermine in 1773, the ghost of Juan de Fuca's strait would have been laid much sooner, and La Pérouse himself would not have been sent to look for it in 1785.

The author has achieved the rare feat of writing a solid scholarly work that is at the same time delightfully readable and sometimes even humorous. There are two reasons for this, other than her own easy flowing style. The first is that she quotes a good deal from her sources, which have the immediacy of all first-hand narration and the piquancy of style and language of their period. And secondly she is obviously deeply interested in people, and it is real people, not dusty historical events, that one finds in her pages. Some of them are highly colourful characters, too, like the whaler Jean Vrolicq, a sort of sea-going Vicar of Bray, who sailed under whatever colours seemed expedient at the time. Or like Jean-François Regnard, successful writer of comedies, who made a journey to Lapland in 1681, and wrote a detailed and entertaining account of the country and the people, which he lifted whole from a recent but obscure text on Lapland written in Latin by a naturalized Swede from Strasbourg. Unfortunately on his return to Paris he found that this work had just been translated into French, English, German and Dutch and was in all libraries. His own account had to be shelved, but was published after his death and became a best-seller, being looked on as a model of travel literature. And with some reason, if the following comment on the robust health of the Lapps is typical: "Ne connaissant point de médecins, il ne faut pas s'étonner s'ils ignorent aussi les maladies.".

The book is well but unobtrusively documented and has a good bibliography, but lacks an index, which would be very valuable to a work of this kind. It is illustrated by some interesting historical maps, some of which however suffer from illegibility as a result of poor reproduction. The two supposedly modern maps, on the other hand, which are presumably intended for general reference, are not only illegible but of such a staggering antiquity as to leave the reader gasping. The one of the Arctic is pre-1914, showing neither the islands discovered by Stefansson nor Severnaya Zemlya. But it is churlish to complain of trifles in a work of such excellence and charm. A second volume, bringing the story up to date, is in preparation and will I am sure be eagerly awaited by all who sample the first.

MOIRA DUNBAR

INGALIK MENTAL CULTURE

By CORNELIUS OSGOOD. *New Haven: Yale University Publications in Anthropology. No. 56, 1959. 9¾ x 6¾ inches, 195 pages, map, 10 text figures. $2.50.*

This is the third and final monograph of a detailed ethnographic account of the Athapaskan-speaking Ingalik Indians living in the area of the lower Yukon River of Alaska. The first volume, Ingalik Material Culture, appeared in 1940; the second, Ingalik Social Culture, in

1958. As might be expected from the title the present work deals in part with ideas about the products and behaviour of the Ingalik discussed in the first two monographs. This threefold division of ethnographic material is often alluded to in anthropological literature, but seldom used to the extent found in the present study.

For Osgood culture consists of all ideas concerning human beings that have been communicated to one's mind and of which one is conscious. This conceptual frame of reference leads the author to distinguish between: (1) ideas of material products; (2) ideas of human behaviour; and (3) ideas *about* the ideas of the people under observation. Categories (1) and (2) deal with empirically verifiable ideas, whereas mental culture deals with non-empirical ideas, i.e., ideas that are never directly perceptible and that can only be inferred through interviewing. To understand Osgood's theoretical scheme, a clear distinction between non-empirical ideas *about* things and empirical ideas *of* things is therefore essential.

Osgood begins his discussion of Ingalik mental culture by presenting their ideas about the natural world, followed by their ideas about their manufactures and behaviour, and finally presenting their ideas on non-empirical matters. This approach — moving from thoughts about the outer world to those innermost in the mind of the individual — is similar to that found in Osgood's study of Ingalik social culture. In the earlier monograph behaviour involving most of the village was discussed first, followed by behaviour of the household group, the relationship between two persons, and finally the actions of the individual by himself.

In the present volume beliefs about the natural world are subdivided into sections on anatomy and physiology, animal life, and plant life. The variety of information contained in these sections should make some of it interesting to ethno-botanists and zoologists as well as anthropologists, although the material was not specifically written with the first two groups in mind. It is interesting to note, for example, that the Ingalik distinguish between five kinds of mice — some of which turn out to have a highly significant place in their spiritual world. Scientific names for many animals and plants are given in an appendix.

Beliefs about the social world include discussions of Ingalik attitudes toward neighbouring peoples; personality types and related emotional matters; economics, with particular reference to ideas about wealth, property, health, disease and its prevention, history and language, art and music. Unfortunately, relatively little attention is given to Ingalik attitudes toward kinship and family life.

Of great interest is Osgood's account of the Ingalik philosophical and spiritual world. By skilful blending of exposition and narrative the reader is given an excellent reconstruction of their value system, cosmology, and religion. Detailed accounts of Ingalik animal "songs", i.e., brief incantations, and attitudes toward the use of amulets and shamans illustrate well the means by which these Athapaskan people tried to resolve their anxieties about the natural world. The young man who was able to purchase a few "good songs" need not be unduly worried about his success in hunting, fishing, and other activities, for the power inherent in such songs ensured good fortune in these endeavours. Not all songs were "good", however, and anyone wishing to give a song away for practically nothing was looked upon with suspicion.

The final section of the monograph contains Osgood's own analysis and commentary on the preceding material. His discussion of problems involved in obtaining data on Ingalik values is particularly informative and contains an important warning to all ethnographers interested in this area: "I tried to compose a list of questions which would give me the data indirectly, but the results were hardly rewarding. What I did learn was that I had increased my own ideas of Ingalik value theory, which is a somewhat different matter. I resolved to try not to substitute the investigator's ideas, however, for those of the people being studied, a transposition which I am

afraid happens only too often when one is dealing with abstractions" (p. 165).

Much of the field work for this study was done between 1934 and 1937 although the area was briefly revisited in 1956. On this last trip Osgood found that his old key informant of earlier days had forgotten much of his knowledge of traditional Ingalik life. There is no better reminder of the speed with which these old arctic cultures are disappearing.

NORMAN A. CHANCE

GEOGRAPHICAL NAMES IN THE CANADIAN NORTH

The Canadian Board on Geographical Names has adopted the following names and name changes for official use in the Northwest Territories and Yukon Territory. For convenience of reference the names are listed according to the maps on which thep appear. The latitudes and longitudes given are approximate only.

Chart 7658 Holman Island and Approaches
(Adopted March 3, 1960)
Name change

Holman (settlement)	70°43′N.	117°43′W.	not Holman Island (settlement)

Chart 7641 Pearce Point Harbour
(Adopted March 3, 1960)

Pearce Point Harbour	69°49′N.	122°41′W.
Ship Island	69°51′	122°44′
Saddleback Point	69°50′	122°42′
M'Leay Point	69°50′	122°38′
Breakwater Spit	69°50′	122°40′
Hub Islet	69°49′	122°41′
Police Flat	69°49′	122°41′

Norman Wells 96 E
(Adopted March 3, 1960)

Willard Island	65°31′N.	127°44′W.	
Six Mile Island	65°14′	126°42′	
Ten Mile Island	65°12′	126°33′	
Link Bend	65°08′	127°39′	
Paige Mountain	65°37′	127°43′	
Hoosier Ridge	65°25′	127°36′	
Kee Scarp (ridge)	65°18′	126°43′	
Vermilion Ridge	65°10′	126°09′	
Oscar Creek Gap	65°28′	127°22′	
Loretta Canyon	65°06′	127°56′	
Dodo Canyon	65°01′	127°20′	
Chasm Creek	65°39′	127°36′	
Rusty Creek	65°38′	127°40′	
Greenhorn Creek	65°36′	127°43′	
Elliot Creek	65°31′	127°39′	
Walker Creek	65°22′	127°57′	
Fair Creek	65°29′	127°46′	
Windy Creek	65°27′	127°42′	
Red Rock Creek	65°11′	127°28′	
Devo Creek	65°25′	127°30′	
Soaking Creek	65°11′	127°26′	
Schooner Creek	65°18′	126°41′	
Snowshoe Creek	65°15′	126°31′	
Grafe River	65°06′	127°25′	
Gus Creek	65°08′	126°43′	
Mac Island	65°16′	127°05′	not Mac's Island
Frenchy Island	65°15′	126°50′	not Frenchy's Island

Mount Thomas	65°33′	127°34′	not Thomas Mountains
Mount Richard	65°33′	127°18′	not Richard Mountains
Mount Morrow	65°29′	127°28′	not Morrow Mountains
Discovery Ridge	65°21′	126°45′	not Discovery Range
Majel Lake	65°15′	127°42′	not Lake Majel
Twentyfive Mile Lake	65°00′	127°00′	not 25 Mile Lake
Billy Creek	65°20′	127°10′	not Billy George Creek
Twentyfive Mile Creek	65°02′	127°18′	not 25 Mile Creek
Altered application			
Hanna River	65°43′	128°42′	

Chart 7626 Approaches to Tuktoyaktuk Harbour
(Adopted March 3, 1960)

Tibjak Point	69°34′N.	133°01′W.
Topkak Shoal	69°30′	133°04′
Beluga Reef	69°29′	133°01′
Beluga Point	69°29′	133°00′
Toker Summit	69°37′	132°55′
Lake Summit	69°36′	132°58′
Tininerk Bay	69°37′	132°58′
Tareoknitok Lagoon	69°26′	133°02′
Altered applications		
Ptarmigan Point	69°26′	133°01′
North Peak	69°35′	132°56′
Triple Summit	69°31′	132°55′
Shore Summit	69°31′	132°59′
Stick Summit	69°29′	132°58′
Bare Summit	69°29′	132°59′
Ice Lake	69°26′	133°02′
Tuktoyaktuk Harbour	69°26′	132°58′

Fort McPherson 106 M
(Adopted March 3, 1960)

Willow River	68°08′N.	135°15′W.	
Mackenzie Delta	68°12′	134°45′	
Peel Plateau	66°20′	133°00′	
Nevejo Lake	67°19′	134°08′	not Nevejo Tchro
Altered application			
Shiltee Rock	67°17′	134°55′	

Bell River 116 P
(Adopted March 3, 1960)
Name Change

Scho Creek	67°44′N.	136°07′W.	not Bear Creek

Kluane Lake 115 G
(Adopted March 3, 1960)
Name change

Cluett Creek	61°16′N.	138°47′W.	not Klewitt Creek nor Bert Creek

Nansen Sound 560 S½
(Adopted April 7, 1960)

Bjare Strait	81°36′N.	91°45′W.
Aurland Fiord	81°04′	94°15′
Rens Fiord	81°10′	93°45′
Emma Fiord	81°28′	89°00′
Jugeborg Fiord	81°15′	89°28′
Bukken Fiord	80°43′	94°55′
Bunde Fiord	80°36′	94°55′
Stang Bay	80°31′	89°51′
Sverdrup Channel	79°55′	97°30′
Bals Fiord	80°23′	95°45′
Li Fiord	80°05′	95°25′
West Cape Fiord	80°13′	95°30′
Flat Sound	80°15′	89°00′
Cape Stallworthy	81°22′	94°15′
White Point	81°13′	90°28′
Perley Island	80°11′	99°15′

Cape Northwest	80°21′	96°40′	
Bad Weather Cape	80°09′	96°40′	
Li Point	80°10′	95°45′	
White Mountain	80°33′	89°39′	
Audhild Bay	81°37′	90°30′	not Audhild Fiord
Henson Bay	81°54′	89°30′	not Mat Henson Bay
Krueger Island	81°35′	91°53′	not Krüger Island
Kleybolte Peninsula	81°45′	91°00′	not Kleybolte Island
Schei Peninsula	80°15′	88°00′	not Schei Island
(Adopted June 9, 1960)			
Altered applications			
Cape Stallworthy	81°24′N.	93°45′W.	
Cape Thomas Hubbard	81°22′	94°15′	

Chart 6388 Sans Sault Rapids
(Adopted April 7, 1960)

North Rapids	65°47′N.	128°48′W.	
North Hanna Island	65°45′	128°43′	
Black Rock	65°43′	128°46′	
Hanna Island	65°44′	128°42′	
Dummit Islands	65°45′	128°47′	not Clamshell Islands nor Brushy Islands nor Duo-du-Kena Islands

Whitehorse 105 D
(Adopted April 7, 1960)
Established names

Antimony Creek	60°11′N.	135°19′W.	
Tally-Ho Creek	60°15′	135°04′	not Tally-Ho Gulch
Tally-Ho Mountain	60°14′	135°03′	not Tally-ho Mountain

Fort Selkirk 115 NW and 115 NE
(Adopted April 7, 1960)

Old Trail Creek	63°26′N.	137°48′W.	not Adami Mountain
Robbed Creek	63°24′	137°31′	
Mount Adami	63°19′	138°01′	

Aberdeen Lake 66 SW and 66 SE
(Adopted May 5, 1960)

Buliard Lake	66°02′N.	99°15′W.	
Upper Garry Lake	65°50′	100°48′	
Lower Garry Lake	65°52′	99°36′	
Name change			
Upper Macdougall Lake	66°00′	98°45′	not Macdougall Lake
Lower Macdougall Lake	66°00′	98°37′	not Macdougall Lake
Altered application			
Garry Lake	65°58′	100°18′	

Chart 7703 Hat Island to Simpson Strait
(Adopted May 5, 1960)

Leader Island	68°24′N.	100°09′W.	
Clove Island	68°25′	100°02′	
Zeta Island	68°24′	100°04′	
Spline Island	68°37′	99°45′	
Peterhead Islands	68°34′	99°57′	
Ambush Rock	68°32′	99°53′	
Wiik Island	68°31′	99°35′	
Sountag Creek	68°56′	98°47′	
Kirkwall Island	68°30′	99°10′	not Etah Island
Altered application			
Wilmot and Crampton Bay	68°11′	98°45′	

Chart 7121 Cape Mills to Cape Rammelsberg
(Adopted June 9, 1960)

Lapointe Rock	63°21′N.	68°14′W.
Biserial Reefs	63°21′	68°07′
Camp Island	63°21′	68°08′
Canaille Point	63°20′	68°08′
Metela Island	63°20′	68°08′

Anchorage Island	63°19′	68°16′	
October Shoal	63°17′	68°10′	
Kungo Reef	63°19′	68°10′	
Kungo Island	63°19′	68°09′	
Sliver Island	63°18′	68°06′	
Scaur Point	63°18′	68°05′	
Ayde Point	63°15′	68°02′	
Whistler Point	63°17′	68°07′	
Farbusher Point	63°15′	68°04′	
Wedge Island	63°16′	68°08′	
Pugh Point	63°11′	68°04′	
Wiskukun Island	63°12′	68°03′	
Staith Point	63°13′	68°01′	
Beluga Point	63°12′	68°00′	
Nest Island	63°12′	68°00′	
Montcalm Point	63°14′	68°01′	
Hare Point	63°14′	68°00′	
Benoe Point	63°14′	67°59′	
Basset Point	63°12′	67°57′	
Agitator Reef	63°11′	67°58′	
Aiguille Shoal	63°10′	67°57′	
Sepiment Rocks	63°11′	67°56′	
Sackville Point	63°11′	67°55′	
Redan Island	63°10′	67°53′	
Fletcher Reefs	63°11′	67°51′	
Scalene Island	63°09′	67°49′	
Eden Island	63°09′	67°42′	
Gander Islet	63°09′	67°41′	
Gosling Islet	63°08′	67°40′	
Kittiwake Rocks	63°08′	67°42′	
Skua Point	63°07′	67°48′	
Outremont Point	63°06′	67°41′	
Dundalk Point	63°06′	67°40′	
Whiskukun Channel	63°15′	68°07′	
False Haven	63°14′	68°00′	
Outer Peak Reef	63°24′	67°52′	not Outer Peak Shoals
Quadrifid Island	63°18′	68°08′	not Quadrifid Islands
Nesters Islet	63°08′	67°40′	not Nester Islet
Pike-Resor Channel	63°15′	68°02′	not Pike-Resor Passage
Fletcher Channel	63°15′	67°57′	not Fletcher Passage
Daniel Island Harbour	63°06′	67°43′	not Daniel Island Harbor (Lion's Den)

King Christian Island 69 SW and 69 SE
(Adopted June 9, 1960)
Established Name

Saffron Hill	76°39′N.	98°27′W.	

Kingak Island 87 A/1
(Adopted June 9, 1960)

Kingak Island	68°09′N.	112°16′W.	
Akvitlak Islands	68°12′	112°14′	
Takhoalok Island	68°10′	112°07′	

Nanukton Island 87 A/2
(Adopted June 9, 1960)

Nanukton Island	68°09′N.	112°49′W.	
Mangak Island	68°11′	112°45′	
Anchor Island	68°08′	112°47′	not Ipikvikhak Island

Black Berry Islands 87 A/3
(Adopted June 9, 1960)

Hokagon Island	68°15′N.	113°13′W.	
Haodlon Island	68°02′	113°18′	
Hatoayok Island	68°13′	113°30′	
Kabviukvik Island	68°11′	113°13′	
Black Berry Islands	68°14′	113°18′	not Paongaktun Islands

Oterkvik Point 87 A/15
(Adopted June 9, 1960)

Oterkvik Point	68°29′N.	112°35′W.	

Nauyan Islands 87 A/16
(Adopted June 9, 1960)

Nauyan Islands	68°29′N.	112°17′W.	
Outcast Islands	68°26′	112°28′	not Ehokhinoak Islands
Altered application			
Miles Islands	68°28′	112°15′	

Camping Island 87 A/20
(Adopted June 9, 1960)

Camping Island	68°36′N	113°52′W.	not Ikagtoklikyoak Island nor Bolt Island nor East Lambert Island nor Rasmussen Island nor Ekatolikyoak Island
Little Camping Island	68°36′	113°43′	not Ikagtoklinoak Island nor Able Island

Howard Bay 87 A/29
(Adopted June 9, 1960)

Ipiolik Point	68°50′N.	113°40′W.	
Landfall Point	68°56′	113°37′	not Hingetkavik Point
Big Rock Point	68°54′	113°39′	not Oyagakyoak Point
Howard Bay	68°51′	113°38′	not Leo Manning Bay nor Manning Bay

Chart 7682 Murray and Richardson Islands
(Adopted June 9, 1960)

Edinburgh Channel	68°28′N.	111°03′W.	
Marker Islets	68°29′	111°22′	
Edinburgh Island	68°31′	110°51′	
Orkney Point	68°28′	110°56′	
Bate Islands	68°23′	111°17′	
Sesqui Islands	68°17′	110°43′	
Outpost Islands	68°22′	110°53′	not Koihok Islands

Ogilvie Range 106 SW and 106 SE
(Adopted June 9, 1960)
Name change

Carcajou Range	65°08′N.	128°25′W.	not Carcajou Mountains

Port Brabant 107 SW and 107 SE
(Adopted June 9, 1960)
Name confirmation

Grassy Point	69°44′N.	128°58′W.	not Perner Point nor Schooner Landing Point

Chart 7604 Kugmallit Bay
(Adopted June 9, 1960)
Altered application

Warren Point	69°45′N.	132°18′W.

Chart 7752 Wilkins Point
(Adopted July 7, 1960)

Brenda Island	68°36′N.	94°03′W.
Minna Island	68°38′	93°58′
Altered application		
Wilkins Point	68°47′N.	93°37′W.

King William Island 67 SW and 67 SE
(Adopted July 7, 1960)
Name confirmation

James Ross Point	68°28′N.	96°31′W.

Chart 7702 Jenny Lind Island to Hat Island
(Adopted July 7, 1960)

Clestrain Point	68°35′N.	101°48′W.
Borge Island	68°31′	100°56′
Amundsen Island	68°27′	100°47′
Delta Island	68°36′	100°01′
Finger Island	68°21′	100°18′

Helmer Hansen Point	68°20′	100°14′	
Spade Island	68°20′	100°04′	
Northpost Island	68°20′	100°01′	
Southpost Island	68°19′	100°01′	
Tiller Island	68°19′	100°03′	
Footprint Island	68°19′	100°04′	
Kettle Island	67°50′	102°32′	
Guard Island	68°29′	100°24′	not Guard Islands
Grenadier Island	68°29′	100°24′	not Guard Islands
Altered application			
Nordenskiöld Islands	68°28′	100°48′	

Chart 7095 Cornwallis Island to Lougheed Island
(Adopted July 7, 1960)

Bradford Island	75°26′N.	101°14′W.	
Name change			
Cape Benjamin Smith	75°54′	95°05′	not Cape Smith

Tathlina Lake 85 C
(Adopted July 7, 1960)

Escarpment Lake	60°35′N.	116°12′W.	
Desmarais Lake	60°51′	116°49′	
Goose Egg Lakes	60°11′	116°44′	
Heart Lake	60°50′	116°38′	
Gull Creek	60°48′	117°42′	
Twin Falls Creek	60°31′	116°12′	
Swede Creek	60°17′	116°33′	
Alexandra Falls	60°30′	116°16′	
Lady Evelyn Falls	60°58′	117°19′	
Louise Falls	60°30′	116°14′	
Grumbler Rapids	60°13′	116°36′	not Grumbler Rapid

Mills Lake 85 E
(Adopted July 7, 1960)

Whittaker Falls	61°09′N.	119°50′W.	
Table Rock Rapids	61°13′	119°55′	not Table Rock Rapid
Coral Falls	61°08′	119°50′	not Third Falls

Falaise Lake 85 F
(Adopted July 7, 1960)

Willow Point	61°09′N.	117°02′W.	
Birch Islands	61°11′	116°54′	not Birch Island
Name confirmation			
Fort Providence (post office)	61°20′	117°41′	not Providence (settlement)
Altered application			
Bluefish River	61°31′	117°58′	

Sulphur Bay 85 G
(Adopted July 7, 1960)

Prairie Lake	61°29′N.	115°58′W.	
Long Island Shoals	61°41′	114°46′	not Long Island Shoal

Lac La Martre 85 M
(Adopted July 7, 1960)

Cartridge Plateau	63°51′N.	119°30′W.	not Cartridge Mountain nor Cartridge Escarpment nor Cartridge Hills

Coppermine 86 NW and 86 NE
(Adopted July 7, 1960)
Established Name

Fault River	66°38′N.	117°36′W.	

Norman Wells 96 E/7
(Adopted July 7, 1960)

Seepage Lake	65°18′N.	126°49′W.	
D.O.T. Lake	65°16′	126°41′	
Hodgeson Lake	65°18′	126°39′	not Fish Lake
Joe Creek	65°16′	126°39′	not Joe's Creek

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